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ICAICTSEE – 2016

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Dear Colleagues,

On behalf of the Conference Committees I have the honor and pleasure to thank you all for your true participation in the work of the ***6th International Conference on Application of Information and Communication Technology and Statistics in Economy and Education (ICAICTSEE-2016)****, http://icaictsee.unwe.bg/, which took place on December 2-3rd, 2016 at the University of National and World Economy (UNWE), Sofia, Bulgaria.*

I would like specially to express my gratitude to all of the program committee members for their genuine support without which it would never had happened.

Due to the current state of scientific development in all spheres of human activity, the constant knowledge and skill actualization of the academia and researchers in the field of Information and Communication Technology (ICT) is an obligatory necessity, especially when the world is in a global economic and financial crisis. The definition of long-term scientific research tasks in this area has a strategic importance, which is even truer for young researchers, lecturers and Ph.D. students.

The conference aims were conducting analysis of the current problems and presenting results of the ICT application in different areas of economy, education and related areas of scientific knowledge; outlining the existing possibilities for the application of modern ICT tools, methods, methodologies and information systems in economy and education; discussing advanced and emerging research trends with a long-term importance in the field of ICT application in economy and education.

The conference has established an academic environment that fosters the dialogue and exchange of ideas between different levels of academic and research communities.

The conference outcome is 104 published research papers (29 from foreign participants), the explosion of fresh ideas and the establishment of new professional relations.

I do hope to meet you all again at ICAICTSEE – 2017 (http://icaictsee.unwe.bg/)!

Dimiter G. Velev
ICAICTSEE-2016 Chair

CONTENTS

Improve the Efficiency of Intrusion Detection Systems Using the Method of Classification of Network Packets

Madjit Karimov, Komil Tashev, Nurbek Nasrullayev

Tashkent University of Information Technologies, Tashkent, Uzbekistan
dr.mmkarimov@rambler.ru , k.akhmatovich@gmail.com , n.bakhtyarovich@gmail.com

Abstract. In this article the architecture of intrusion detection system based on the use of a hardware implementation of the classification of network packets, which allows you to increase the speed of processing information to protect against network intrusions during the operation in information and communication systems.

Keywords. Intrusion detection system, Network packets, Classification of network packets, Preprocessors, Deep packet inspection, Stateful inspection, Packet header, Detection engine, header matching

1. Introduction

The proliferation of Internet and networking applications, coupled with the wide-spread availability of system hacks and viruses, urges the need for network security. The security of digital information systems has an increasing impact on modern societies and economies. Information is most valuable when (safely) circulated and hence, network security is a critical issue with great financial impact and significant effect on society. Private industries in finance, trade, services, transportation, manufacturing, and public sectors such as medical, vital services, national economy, defense and intelligence depend on computing systems. Consequently, any information and network security failure of these systems may often result in significant economic damage or disasters. Recent analyses show the economic impact of network security.

2. Intrusion detection system

High speed and always-on network access is commonplace around the world creating a demand for more sophisticated packet processing and increased network security. The answer to this sophisticated network processing and network security can be provided by Deep Packet Inspection (DPI). In essence, deep packet inspection is able to accurately classify and control traffic in terms of content and applications. In other words, it analyses packets content and provides a content-aware processing. The most challenging task in DPI is content inspection, since the body (payload) of each packet needs to be scanned [1, 2]. In general, DPI systems should provide the following:

- high processing throughput,
- low implementation cost,
- flexibility in modifying and updating the content descriptions, and
- scalability as the number of the content descriptions increases.

Although, the principles followed in all DPI network applications remain unchanged, we can note that in NIDS the content descriptions may be more complex and more in number,

creating significant performance limitations and implementation difficulties compared to other network applications such as content-aware traffic management and switching.

3. Related works

Intrusion Detection Systems (IDS) use several preprocessors and a ruleset-based detection engine which performs packet classification and content inspection. Figure 1 illustrates a breakdown of an intrusion detection system. It is worth noting that the described IDS generates per packet alerts and subsequently correlations between multiple alerts may indicate a complete attack plan. An IDS rule such as the ones of Snort and Bleeding [3] open source IDS, consists of a header matching part and a payload matching part. The first one checks the header of each incoming packet using packet classification techniques. The second examines the payload of each packet performing content inspection. Content Inspection involves matching packet payload against predefined patterns either described as static patterns or regular expressions. Additional restrictions concerning the placement of the above patterns introduce further complexity to the processing of the IDS tasks. Below, each IDS task is discussed in detail.

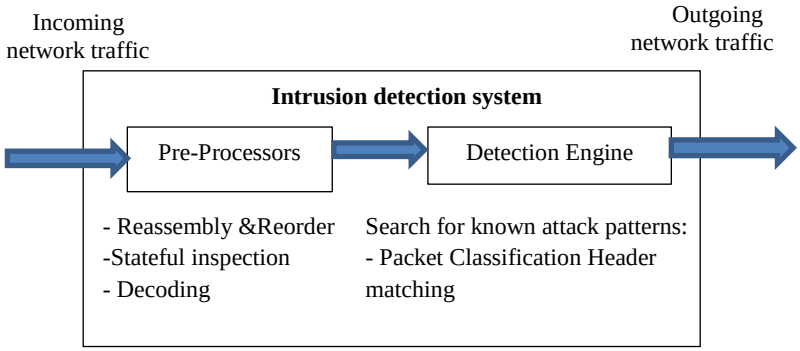

Fig.1. General structure of intrusion detection system

Preprocessors: The IDS preprocessors implement the necessary functions that allow the subsequent detection engine to correctly examine incoming traffic against predefined attack descriptions. Preprocessors are responsible for three kinds of tasks. First, they reassemble and reorder TCP packets into larger ones. This is necessary in order to detect attacks that span across multiple packets. Second, they perform stateful inspection functions such as flow tracking or portscan detection; that is, functions related to the protocol level that keep track of different connections/flows. Stateful inspection can also be seen as a module which has an overview of the traffic -at a higher level than the content inspection- checking for abnormal events such as buffer overflows or Denial of Service (DoS) attacks. Third, preprocessors perform specialized inspection functions, mostly decoding of various kinds of traffic, e.g., Telnet, FTP, RPC, HTTP, SMTP, packets with malicious encodings, etc.

After the preprocessors comes the detection engine which uses a rule database (ruleset) to describe malicious packets. Each rule has a packet classification and a content inspection part. Furthermore, content inspection includes static pattern matching, regular expression matching and pattern placement restrictions.

Packet Classification: The header part of each NIDS rule describes the header of a potentially dangerous packet. As depicted in Figure 2, the header description may consist of

some or all the following: Protocol, Destination IP and Port and Source IP and Port. The IP and Port fields of a rule may specify ranges of values instead of a specific address or port. This makes packet classification more challenging than a simple comparison of numerical values. Many researchers in the past have proposed different techniques for packet classification and IP lookup such as [4], while some of them also use reconfigurable hardware. This method achieves high performance and fits well within the proposed reconfigurable designs.

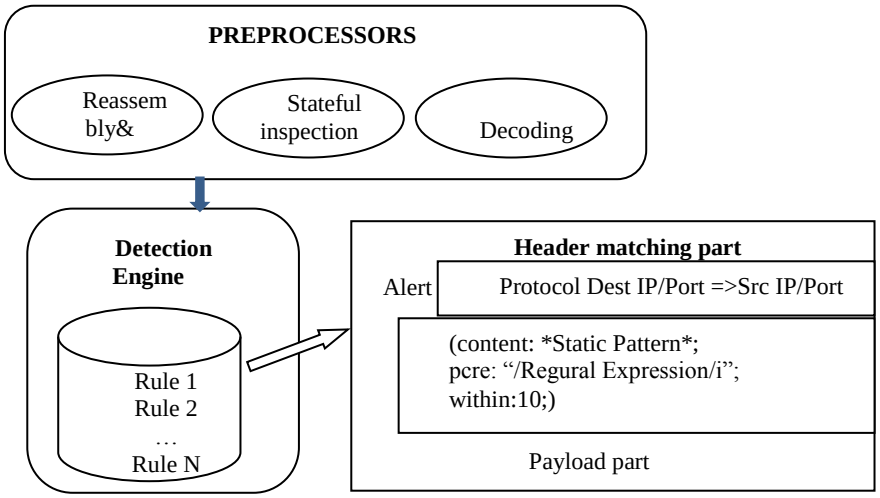

Fig.2. Functional scheme of intrusion detection system

In traditional 5-tuple packet classification, an IP packet is usually classify dbase don't he fields in the packet header: the 32-bit source/destination IP addresses (denoted SA/DA), 16-bit source/destination port numbers (denoted SP/DP), and 8-bit transport layer protocol. Individual entries for classifying a packet are called rules. Each rule can have one or more fields and their associated values, a priority, and an action to be taken if matched. Different fields in a rule require different kinds of matches: prefix match for SA/DA, range match for SP/DP, and exact match for the protocol field.

Next-generation packet classification aims to match a larger number of header fields. The recently proposed OpenFlow switch [3] enables network virtualization and brings programmability and flexibility to the network infrastructure. The major processing engine in the OpenFlow switch is packet classification, where up to 12-tuple header fields of each packet are matched against all the rules [3]. The 12-tuple header fields supported in the current OpenFlow specification include the ingress port, source/destination Ethernet addresses, Ethernet type, VLAN ID, VLAN priority, source/destination IP addresses, IP protocol, IP Type of Service bits, and source/destination port numbers [3]. Table II shows the width of each field.

Each field of an OpenFlow rule can be specified as either an exact number or a wildcard. IP address fields can also be specified as a prefix. Table shows a simplified example of OpenFlow rule table, where consider 16-bitEth src/dst, 8-bit SA/DA, and 4-bit SP/DP.In the subsequent discussion, have the following definitions.

• Simple rule is the rule of which all the fields are specified as exact values, e.g., R10 in Table III.

• Complex rule is the rule containing wildcards or prefixes.

A packet is considered matching a rule only if it matches all the fields within that rule. A packet can match multiple rules, but only the rule with the highest priority is used to take action.

4. Method of classification of network packets

A. Rule Set Partitioning

1) Motivation: Decision-tree-based algorithms (such as HyperCuts) usually scale well and are suitable for rule sets where the rules have little overlap with each other. But they suffer from rule duplication which can result in O(Nd) memory explosion in the worst case, where N denotes the number of rules and the number of fields in a rule. Moreover, the depth of a decision tree can be as large as O(W), where W denotes the total number of bits per packet for lookup. d=12, W>237 in OpenFlow. For the example, if consider only SA and DA fields, decision-tree-based algorithms such as HyperCuts [5] cut the search space recursively based on the values from SA and DA fields. No matter how to cut the space, R1–4 will be duplicated to all children nodes. This is because their SA/DA fields are wildcards, i.e., not specified. Similarly, if we build the decision tree based on source/destination Ethernet addresses, R5–8 will be duplicated to all children nodes, no matter how the cutting is performed.

Hence an intuitive idea is to partition a table of complex rules into different subsets. The rules within the same subset specify nearly the same set of header fields. For each rule subset, we build the decision tree based on the specified fields used by the rules within this subset. For instance, the example rule table can be partitioned into two subsets: one contains the rules R1–4 and the other contains R5–10. We can use only source/destination Ethernet addresses to build the decision tree for the first subset while only SA/DA fields for the second subset. As a result, the rule duplication will be dramatically reduced. Mean-while, since each decision tree after such partitioning employs a much smaller number of fields than the single decision tree without partitioning, we can expect considerable resource savings in hardware implementation.

2) Algorithm: We develop the rule set partitioning algorithm to achieve the following goals:

- reduce the overall memory requirement;
- bound the depth of each decision tree;
- bound the number of decision trees.

Rather than perform the rule set partitioning and the decision tree construction in two phases, we combine them efficiently in the algorithm. The outcome of the algorithm is multiple decision trees, which we call decision forest. The rule set is partitioned dynamically during the construction of each decision tree. The function for building an optimized decision tree i.e., BuildTree (-) is detailed in Fig. 4 in Section IV-B.

The parameter P bounds the number of decision trees in a decision forest. We have the rule set Ri to build the ith tree whose construction process will split out the rule set Ri+1. i=0,1,…,P-1. In other words, the rules in Ri=Ri+1 are actually matched in the ith tree. The parameter split determines if the rest of the rule set will be partitioned. When building the last decision tree, split is disabled so that all the remaining rules are used to construct the tree. The rule duplication in the first P-1 trees will thus be reduced. Other parameters include depthBound which bounds the depth of each decision tree, and listSize which is inherited from the original HyperCuts algorithm to determine the maximum number of rules allowed to be contained in a leaf node.

The decision tree construction algorithm shown in Fig. 4 is based on the original HyperCuts algorithm, where Lines 6–7 and 17–19 are the major changes related to rule set partitioning. Lines 6–7 are used to bound the depth of the tree. After determining the optimal cutting information (including the cutting fields and the number of cuts on these fields) for the current node, we identify the rules which may be duplicated to the children nodes (by the Potential Duplicated Rule() function). These rules are then split out of the current rule set and

pushed into the split-out rule set Rex. The split-out rule set will be used to build the next decision tree(s).

B. Optimizing HyperCuts

1) Motivation: After rule set partitioning, the rule duplication due to wildcard fields will be reduced. However, the HiCuts/HyperCuts algorithm may still suffer from rule duplication due to its own inefficiency.

We identify that the rule duplication when building the decision tree comes from two sources: 1) overlapping between different rules and 2) evenly cutting on all fields. Since each dimension is always evenly cut, R2 and R4 are replicated though they do not overlap with any other rule. The second source of rule duplication exists only when cutting the port or the protocol fields of the packet header, since the prefix fields are evenly cut in nature. A prefix is matched from the most significant bit (MSB) to the least significant bit (LSB), which is equal to cutting the value space by half per step.

Accordingly, we propose the following two optimization techniques, called rule overlap reduction and precise range cutting.

• Rule overlap reduction: We store the rules (e.g., R1 shown in Fig.3) which will be replicated into child nodes, in a list attached to each internal node. These rule lists are called internal rule lists.

• Precise range cutting: Assuming both X and Y in Fig.3 are port fields, we seek the cutting points which result in the minimum number of rule duplication, instead of deciding the number of cuts for this field.

As shown in Fig. 3, after applying the two optimizations, rule duplication is dramatically reduced. The memory requirement becomes linear with the number of rules. Section IV-B2 discusses the details about building the decision tree.

The proposed rule overlap reduction technique is similar to the push common rule upwards heuristic proposed by the authors of HyperCuts [5], where rules common to all descendant leaves are processed at the common parent node instead of being duplicated in all children. However, the push common rule upwards heuristic can solve only a fraction of rule duplication that is solved by our technique. Taking the HyperCuts tree as an example, only R1 will be pushed upwards while our technique allows storing R2 and R4 in the internal nodes as well. Also, the push common rule upwards heuristic is applied after the decision tree is built, while our rule overlap reduction technique is integrated with the decision tree construction algorithm.

2) Algorithm: Starting from the root node with the full rule set, we recursively cut the tree nodes until the number of rule in all the leaf nodes is smaller than a parameter named listSize. At each node, in this case need to figure out the set of fields to cut and the number of cuts performed on each field. Restrict the maximum number of cuts at each node to be 64. In other words, an internal node can have 2, 4, 8, 16, 32, or 64 children. For the port fields, we need to determine the precise cut points instead of the number of cuts. Since more bits are needed to store the cut points than to store the number of cuts, restrict the number of cuts on port fields to be at most 2. For example, we can have 2cutson SA,4cut son DA,2cutson SP, and 2 cutsonDP. We do not cut on the protocol field since the first 4 fields are normally enough to distinguish different rules in real life [6].

Use the same criteria as in HiCuts [7] and HyperCuts [5] to determine the set of fields to cut (ChooseField()) and the number of cuts performed on SA and DA fields (OptNumCuts()). Our algorithm differs from HiCuts and HyperCuts in two aspects. First, when the port fields are selected to cut, we seek the cut point which results in the least rule duplication. Second, after the cutting method is determined, we pick the rules whose duplication counts are the largest among all the rules covered by the current node, and push

them into the internal rule list of the current node, until the internal rule list becomes full. Fig. 4 shows the decision tree constructed for the rule set.

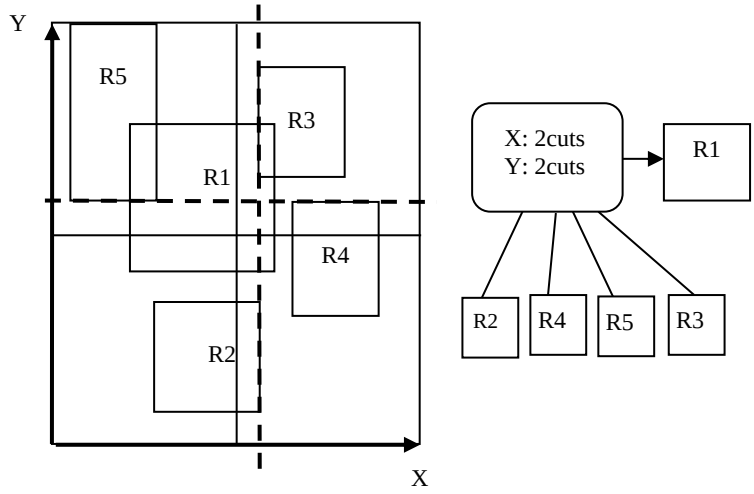

Fig.3. Reducing rule duplication

To achieve line-rate throughput, we map the decision forest including P trees onto a parallel multi-pipeline architecture with P linear pipelines, as shown in Fig. 5, where P=2. Each pipeline is used for traversing a decision tree as well as matching the rule lists attached to the leaf nodes of that tree. The pipeline stages for tree traversal are called the tree stages while those for rule list matching are called the rule stages. Each tree stage includes a memory block storing the tree nodes and the cutting logic which generates the memory access address based on the input packet header values. At the end of tree traversal, the index of the corresponding leaf node is retrieved to access the rule stages. Since a leaf node contains a list of listSize rules, for this need listSize rule stages for matching these rules. All the leaf nodes of a tree have their rule lists mapped onto these listSize rule stages. Each rule stage includes a memory block storing the full content of rules and the matching logic which performs parallel matching on all header fields.

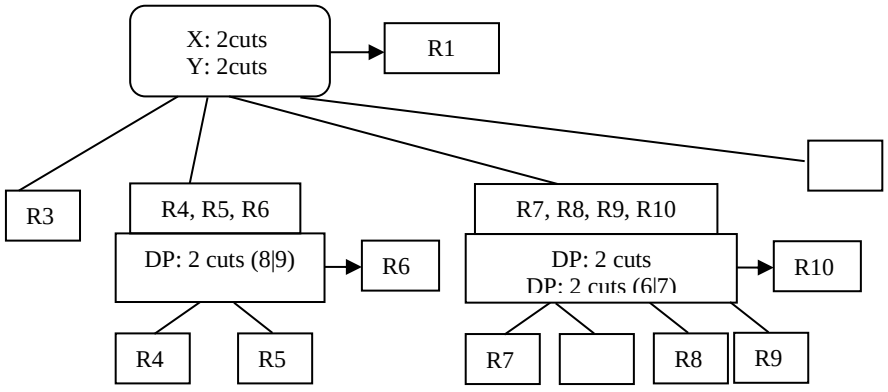

Fig.4. Process of building the detection tree for the rule set

Each in coming packet goes through all the P pipelines in parallel. A different subset of header fields of the packet may be used to traverse the trees in different pipelines. Each pipeline outputs the rule ID or its corresponding action. The priority resolver picks the result with the highest priority among the outputs from the P pipelines. It takes H+list Size clock cycles for each packet to go through the architecture, where H denotes the number of tree stages.

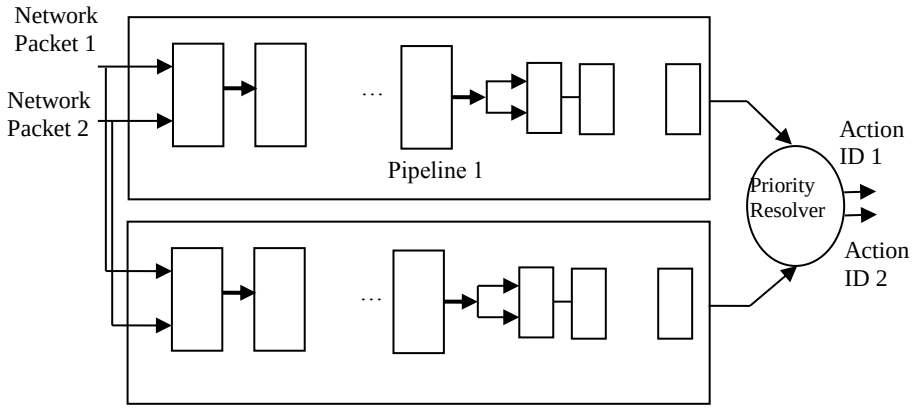

Fig.5. Architecture for searching decisions

This architecture allows to increase the speed of processing of network packets to network intrusion detection plays a not unimportant role in the detection and prevention of attacks in the protection of information and communication systems. This architecture can be illustrated as follows.

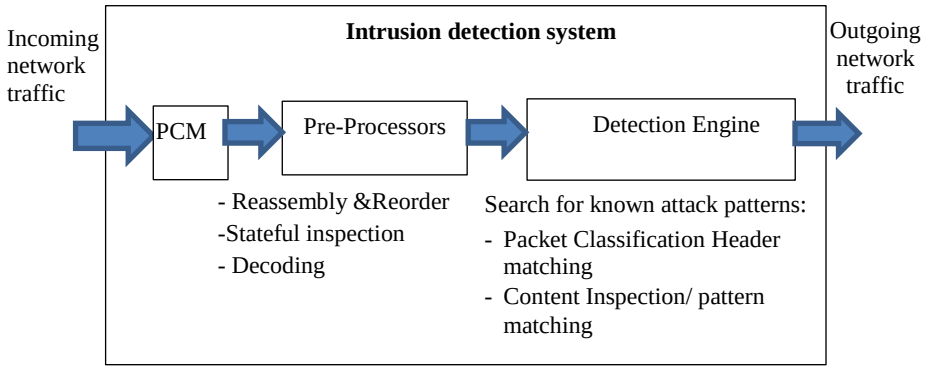

Fig.6. Purposed architecture for intrusion detection system

5. Conclusion

Based on the proposed architecture will be possible to develop ways and methods of construction of systems to detect and prevent attacks by using hardware and software implementation, which will not depend on the resource server information and communication system. It can be concluded that the work in this area will bring great results, while ensuring the information security of information and communication systems.

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Causal Relationship Analysis of the Patient Safety Culture Based on the Chinese Version of Safety Attitudes Questionnaire

Yii-Ching Lee[1], Pei-Shan Zeng[2], Chih-Hsuan Huang[3], Hsin-Hung Wu[4]

[1] Office of Dean, Cheng Ching General Hospital – Chung Kang Branch; The School of Health Policy and Management, Chung Shan Medical University; Department of Health Business Administration, Hung Kuang University, Taichung, Taiwan
yiiching.lee@gmail.com

[2] Department of Business Administration, National Changhua University of Education, Changhua, Taiwan
qwer74185289@gmail.com

[3] School of Business Administration, Hubei University of Economics, Wuhan City, Hubei Province, China
tititacer@163.com

[4] Department of Business Administration, National Changhua University of Education, Changhua, Taiwan
hhwu@cc.ncue.edu.tw

Abstract. This study uses eight dimensions of the Chinese version of safety attitudes questionnaire developed by Taiwan Joint Commission on Hospital Accreditation, invites eleven experts in patient safety culture, and then applies the decision-making trial and evaluation laboratory method (DEMATEL) for analysis. The findings show that perception of management and stress recognition are the two most essential dimensions when causal relationship is taken into consideration, while job satisfaction is the least essential dimension affected by the other seven dimensions followed by teamwork climate and working condition. In addition, stress recognition, perception of management, emotional exhaustion, and burnout are cause-based dimensions, whereas teamwork climate, safety climate, job satisfaction, and working condition are effect-based dimensions. Moreover, the importance of eight dimensions is prioritized as follows: job satisfaction > working condition > teamwork climate > perception of management > emotional exhaustion > safety climate > stress recognition > burnout.

Keywords. Patient safety culture, Chinese version of safety attitudes questionnaire, Causal relationship, DEMATEL method.

1. Introduction

Patient safety has become a critical issue in healthcare organizations. Lee et al. [1] pointed out that better attitude toward patient safety would reduce the number of medical errors and improve the patient safety culture for healthcare organizations. Because hospital employees are the frontline of efforts to provide medical services to the patients, their attitudes toward the patient safety is essential and should be regularly assessed [1]-[3]. Safety attitudes questionnaire (SAQ) developed by Sexton et al. [4] with six dimensions has been translated in different languages and widely used worldwide to evaluate the patient safety culture of

healthcare organizations from employees' viewpoints [2]. In Taiwan, Taiwan Joint Commission on Hospital Accreditation has adopted SAQ from Sexton et al. [4] and then added two dimensions such that the Chinese version of SAQ has eight dimensions since 2014 [3], [5].

Shieh et al. [6] and Shieh and Wu [7] stated that causal relationships among critical factors have been extensively studied in recent years in a wide variety of areas such as airlines safety management, choosing knowledge management strategies, identifying key success factors for hospital service quality, selecting the cost of quality model, and so on. In addition, Shieh et al. [6] summarized that studying causal relationships among critical factors helps the decision maker understand the underlying principles of the relationship and then further make the accurate predictions of future outcomes. Moreover, Lee et al. [8] depicted that identifying causal relationships among factors/dimensions is essentially helpful for any decision maker in a healthcare organization in order to relentlessly improve the patient safety culture. By examining the cause-effect relationship, little improvement is gained through the enhancement of effect-based dimension(s). In contrast, strengthening the causal dimension(s) would have direct improvements on effect-based dimensions.

Decision-making trial and evaluation laboratory (DEMATEL) method is one of the effective methods constructing causal relationships among the factors [6]. This method is to identify the interdependence among the elements of a system through a causal diagram to depict the basic concept of contextual relationships and the strengths of influence among the elements by a hierarchical structure [9], [10]. Lee et al. [8], [11] applied DEMATEL method to analyze the contextual relationships among six and nine dimensions in the respective safety attitudes questionnaire and the Chinese version of SAQ such that the decision maker in healthcare organizations can take improvement actions more effectively from causal viewpoints. The Chinese version of SAQ has been modified since 2014 from the original nine dimensions to the current eight dimensions. There is a need to examine the causal relationships among eight dimensions in order to effectively improve the patient safety culture in healthcare organizations. Therefore, the purpose of this study is to establish the contextual relationships among eight dimensions in the Chinese version of safety attitudes questionnaire.

2. Safety Attitudes Questionnaire

Safety attitudes questionnaire originally developed by Sexton et al. [4] has six dimensions along with thirty questions and has been widely used to assess the patient safety culture. These six dimensions are teamwork climate, safety climate, job satisfaction, stress recognition, perception of management, and working condition [8]. In 2014, Taiwan Joint Commission on Hospital Accreditation has removed three hospital-level aspects of safety culture from Agency for Healthcare Research and Quality which have been included in the previous version. In addition, two dimensions, namely emotional exhaustion and burnout, have been incorporated to form a new version of the Chinese version of SAQ with eight dimensions along with forty six questions [5], [11].

3. DEMATEL Method

Decision-making trial and evaluation laboratory method based on graph theory enables problems to be planned and solved visually such that multiple criteria can be divided into cause and effect groups in order for the better understanding of causal relationships [6]. In addition, DEMATEL method is typically used in a relatively smaller group of experts. Four major steps of DEMATEL method are depicted below [10], [12].

Step 1: Establish the average matrix. Each respondent was asked to evaluate the direct influence between any two dimensions by an integer score of 0, 1, 2, and 3 representing "no influence", "low influence", "medium influence", and "high influence", respectively. The notation of x_{ij} is referred to as the degree to which the respondent believes dimension *i* influences dimension *j*. For *i* = *j*, the diagonal elements are set to zero, representing no influence. An *n*×*n* non-negative matrix is established as $X^k = \left[x_{ij}^k\right]$ for each respondent, where *k* is the number of respondents, and *n* is the number of dimensions. If there are *H* respondents, the average matrix $A = \left[a_{ij}\right]$ is expressed as follows:

$$a_{ij} = \frac{1}{H}\sum_{k=1}^{h} x_{ij}^k \qquad (1)$$

Step 2: Compute the normalized initial direct-relation matrix *D* by $D = A \times S$, where $S = 1 \Big/ \max_{1 \le i \le n} \sum_{j=1}^{n} a_{ij}$. Each element falls between zero and one in matrix *D*.

Step 3: Construct the total relation matrix *T* by $T = D(I - D)^{-1}$, where *I* is the identity matrix. Let *r* and *c* be *n*×1 and 1×*n* vectors representing the respective sum of rows and sum of columns from the total relation matrix *T*. The notation of r_i is to take into consideration both direct and indirect effects given by dimension *i* to the other dimensions by summing the values of *i*-th row in matrix *T*, while the notation of c_j is to take into account both direct and indirect effects by dimension *j* from the other dimensions by summing the values of *j*-th column in matrix *T*. When *j* = *i*, the sum $(r_i + c_j)$ is defined as the total effects given and received by dimension *i*, showing the degree of importance for dimension *i* in the entire system. On the contrary, the difference $(r_i - c_j)$ is defined as the net effect that dimension *i* contributes to the system. Dimension *i* is a net cause when $(r_i - c_j)$ is greater than zero, while dimension *i* is a net receiver or result when $(r_i - c_j)$ is less than zero.

Step 4: Calculate a threshold value for the digraph by computing the average of the elements in matrix *T*. The digraph can be drawn by mapping the dataset of (*r*+*c*, *r*–*c*).

4. Research Method

Thirteen experts in the patient safety culture, medical quality, or human resources management including physicians, nurses, administrators, and professors were invited to fill out the questionnaire developed based on the eight dimensions by the DEMATEL format from April to June 2016 but only eleven surveys have been received effectively. Therefore, the analyses were based on these eleven experts' opinions.

5. Results

The total relation matrix *T* based on these eleven experts' opinions and the procedures depicted in Section 3 is as follows:

$$T = \begin{bmatrix} 2.1848 & 2.1700 & 2.4409 & 1.9412 & 2.1897 & 2.3337 & 2.0551 & 1.9257 \\ 2.1596 & 1.8813 & 2.2663 & 1.8116 & 2.0321 & 2.1665 & 1.9053 & 1.8038 \\ 2.3857 & 2.1924 & 2.3586 & 1.9939 & 2.2262 & 2.3904 & 2.1234 & 2.0214 \\ 2.1900 & 2.0404 & 2.3215 & 1.7570 & 2.0811 & 2.2232 & 1.9828 & 1.8845 \\ 2.3285 & 2.1431 & 2.4389 & 1.9313 & 2.0547 & 2.3237 & 2.0582 & 1.9499 \\ 2.3378 & 2.1668 & 2.4708 & 1.9715 & 2.1960 & 2.2211 & 2.0869 & 1.9909 \\ 2.2460 & 2.0808 & 2.3671 & 1.9140 & 2.1305 & 2.2584 & 1.9005 & 1.9248 \\ 2.052 & 1.8960 & 2.1676 & 1.7408 & 1.9344 & 2.0718 & 1.8474 & 1.6473 \end{bmatrix}$$

Table I summarizes both direct and indirect effects of eight dimensions. The importance of eight dimensions can be prioritized in terms of (r+c) values, i.e., job satisfaction > working condition > teamwork climate > perception of management > emotional exhaustion > safety climate > stress recognition > burnout. Obviously, job satisfaction is the most important dimension, whereas burnout is the least important dimension. In addition to the importance of dimensions, stress recognition, perception of management, emotional exhaustion, and burnout are net causes due to positive (r–c) values. In contrast, teamwork climate, safety climate, job satisfaction, and working condition are net effects with negative (r–c) values. The threshold value computed based on the average of the elements in matrix T is 2.0983. The digraph of these eight dimensions is depicted in Figure 1.

Table I. The direct and indirect effects of eight dimensions

Dimension	r+c	r–c
Teamwork climate	35.1255	–0.6433
Safety climate	32.5973	–0.5443
Job satisfaction	36.5237	–1.1397
Stress recognition	31.5418	1.4192
Perception of management	34.0730	0.3836
Working condition	35.4306	–0.5470
Emotional exhaustion	32.7817	0.8625
Burnout	30.5056	0.2090

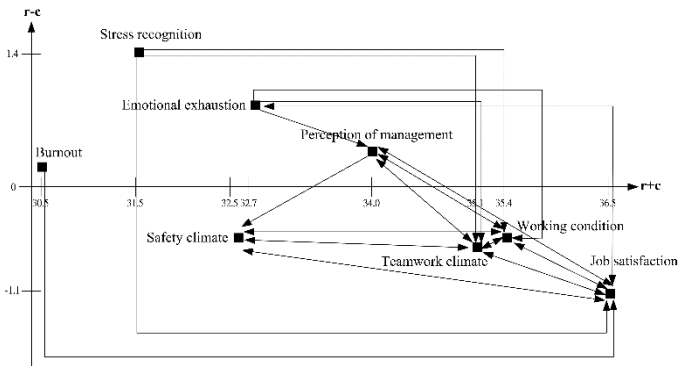

Fig. 1. Digraph of Eight Dimensions of Safety Attitudes Questionnaire

Figure 1 shows that all pairs of perception of management, teamwork climate, working condition, and job satisfaction are mutually influenced. Except for perception of management, teamwork climate, working condition, and job satisfaction are net effects. That is, any improvement from perception of management would result in positive impacts on teamwork climate, working condition, and job satisfaction. Based on the overall assessment, perception of management is the most essential dimension from the contextual relationships among eight dimensions followed by emotional exhaustion. Perception of management has direct influences on job satisfaction, working condition, teamwork climate, and safety climate. That is, when the hospital management intends and then takes actions to improve the patient safety culture, these four net effect-based dimensions could be enhanced. Emotional exhaustion is the second critical dimension from cause-effect relationships. This dimension affects job satisfaction, working condition, and teamwork climate. Moreover, emotional exhaustion directly impacts perception of management.

6. Conclusions

Safety attitudes questionnaire is an effective questionnaire to assess the patient safety culture in healthcare organizations from employees' viewpoints. In Taiwan, the Chinese version of SAQ with eight dimensions has been the driving force to evaluate the patient safety in healthcare organizations. As noted by Lee et al. [11], identifying causal relationships among dimensions is essentially important for the hospital management to systematically improve the patient safety culture relentlessly. Little improvement would be gained if an effect-based dimension is to be enhanced. On the contrary, enhancing the causal dimension(s) would have positive impacts on effect-based dimensions. This study uses DEMATEL method as a basis to analyze the contextual relationships among eight dimensions of the Chinese version of safety attitudes questionnaire. Based on the overall assessment, perception of management is found to be the most essential dimension from cause-effect viewpoints followed by emotional exhaustion. Therefore, the hospital management needs to pay much attention to improve perception of management and emotional exhaustion in order to provide a better patient safety culture for both employees and the patients.

7. Acknowledgement

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The Mediation Effect of Gratitude on the Relationship between Relationship Quality and Patient Loyalty

Yii-Ching Lee[1], Chih-Hsuan Huang[2], Hsin-Hung Wu[3]

[1] Office of Dean, Cheng Ching General Hospital – Chung Kang Branch; The School of Health Policy and Management, Chung Shan Medical University; Department of Health Business Administration, Hung Kuang University, Taichung, Taiwan
yiiching.lee@gmail.com

[2] School of Business Administration, Hubei University of Economics, Wuhan City, Hubei Province, China
tititacer@163.com

[3] Department of Business Administration, National Changhua University of Education, Changhua, Taiwan
hhwu@cc.ncue.edu.tw

Abstract. Healthcare organizations are facing several management challenges and competitive environment, how to enhance physician-patient relationship becomes an essential issue for healthcare organizations to better improve medical quality and patient loyalty. Gratitude has been proven to enhance customer relationship in marketing field; however, the effect of gratitude is still ambiguous in healthcare field. The purpose of this study aims to examine the physician-patient interaction from the viewpoints of relationship marketing, and to further investigate the relationships among relationship quality, patient gratitude, and patient loyalty. The findings reveal that relationship quality has a positive effect on patient loyalty. Additionally, gratitude demonstrates a mediation effect on the connection between relationship quality and patient loyalty. Healthcare management should pay more attention to relationship-oriented elements (such as relationship quality and gratitude) in order to provide a better physician-patient relationship in medical service industries.

Keywords. Gratitude, Relationship quality, Patient loyalty, Mediation effect

1. Introduction

In the past, the interaction between physicians and patients was typically limited to patients' compliance with physicians' instructions, or the relationship was an information exchange for the purpose of treatment [1]. In a physician-patient relationship, both parties need to engage in an interactive process because of the uncertainties and complex process of medical treatment. Various studies on relationship marketing have demonstrated that relationship quality is based on a long-term relationship between customers and providers, and this high-quality relationship is an integral concept that combines satisfaction, trust and commitment [2], [3]. These three components of relationship quality represent the perceptions of evaluation in the relationship, which helps to build a better physician-patient relationship.

Empirical practices of healthcare organizations concerning the enhancement of patient loyalty through maintenance of good relationships with patients are still ambiguous [4]. In the marketing field, gratitude has been widely discussed with reference to building a long-term relationship between a company and customer [5], [6]. Many consumer behavior studies have

examined the role of gratitude in a long-term relationship and further indicate that gratitude is the essential instrument for promoting customer loyalty [7]-[9]. In the field of medical services, it is common that a patient through words or behavior expresses his or her gratitude to the medical staff due to their endeavor to rescue the patient's life and health. However, few studies have clearly identified the connection between patient gratitude and physician-patient relationship. It is critically important to recognize the role of patient's gratitude on the physician-patient relationship. Multiple regression analysis is subsequently conducted to demonstrate the relationships among relationship quality, gratitude, and loyalty. Following this introduction, the second section of this paper presents a review of the literature on relationship quality, gratitude, and loyalty. The third section then illustrates details of the methods used in the empirical study. Finally, the results are discussed.

2. Relevant Literature

Relationship quality is developed from relationship marketing and emphasizes on the establishment of long-term mutually beneficial relationships with individual customers [10]. The improvement of relationship quality can positively influence customers' repeated purchase and word of mouth [11, 12]. Relationship quality consists mainly of the three aspects of satisfaction, trust, and commitment [13, 14]. Satisfaction is an emotional evaluation of the quality and trading relationship, as perceived by customers [15, 16]. Positive customer satisfaction tends to maintain the current trading relationship and to enhance the intentions of repurchase [17]. Trust is a belief of being able to rely on one another in the relationship [18], and a successful relationship will be established based on positive interactions between each other [19]. Commitment is the consumer's desire to continue a relationship with the seller because of a positive attitude, accompanied by the consumer's willingness to maintain the relationship [18]. Higher levels of commitment are correlated with higher levels of retention [19, 20]. It has been proven that an improvement in relationship quality can positively contribute to organizational performance, such as customers' repurchase behavior and promotion by word of mouth [21-23].

Gratitude is a pleasant mood and is a positive experience of the recipient who recognizes the benefit from the giver, which in turn represents his or her feedback [24]. Gratitude occurs when a customer perceives that a company behaves advantageously for the customer [6, 25]. Customers thus feel they should maintain the relationship and express the thankfulness by returning loyalty [6, 26]. As healthcare organizations seek to create a long-term relationship with the patient, understanding how gratitude impacts physician-patient relationship is essential. Patient's gratitude could be an important stimulant for the interaction between the medical staff and patient, since patient's appreciation may have a positive impact on the likelihood of patient's returning to the hospital or promoting the organization through word of mouth.

3. Methodology

Respondents who received medical treatment in any hospital in Taiwan during the year of 2015 were requested to respond to the survey. A total of 800 questionnaires were collected using convenience sampling, and 731 valid questionnaires were used for the analysis. Items from prior research were used as the basis of measurement. Five-point Likert scales anchored by 1 (strongly disagree) and 5 (strongly agree) were used throughout the questionnaire.

Examination of the sample profile showed that majority of respondents were female (65.3percent), age ranged from 21 to 50 years (70.1 percent), and education of the bachelor's level (55.4 percent). Additionally, around one-third of the respondents reported that they worked in the service industry. After screening the data, multiple regression analysis was

conducted to examine the relationships among relationship quality, gratitude, and loyalty.

4. Research Results

As shown in Table I, the Cronbach's α values for all the constructs exceed 0.9, which indicates that the scales had great reliability and internal consistency. Additionally, the highest mean score was observed for trust, while the lowest mean score was on patient loyalty.

Table I. The results of mean, standard deviation, Cronbach's alpha

Research constructs	Mean	Standard Deviation	Cronbach's α
Satisfaction	3.901	0.5435	0.93
Trust	4.011	0.5717	0.94
Commitment	3.821	0.5902	0.90
Patient loyalty	3.744	0.6407	0.91
Patient gratitude	3.940	0.6069	0.94

Mediation conditions were examined to test the mediating effects of patient gratitude. The bootstrapping bias-corrected confidence interval (CI) procedure was used to evaluate the significance and different effects (direct and indirect) in the model. The indirect effect of satisfaction on patient loyalty through patient gratitude was significant (indirect effect = 0.390; 95% bootstrap CI = 0.303 to 0.487; $p < 0.001$) because the confidence intervals did not include zero. The indirect effect of trust on patient loyalty through patient gratitude was also significant (indirect effect = 0.497; 95% bootstrap CI = 0.432 to 0.570; $p < 0.001$). Similarly, the indirect effect of commitment on patient loyalty through patient gratitude was significant (indirect effect = 0.358; 95% bootstrap CI = 0.295 to 0.431; $p < 0.001$). The mediating role of patient gratitude on the relationship between relationship quality and patient loyalty was therefore confirmed.

5. Discussion

In a highly competitive healthcare industry, establishing a close physician-patient relationship, providing good medical services, and strengthening patient loyalty have become keys to a sustainable development of healthcare organizations. The purpose of the current study was to investigate the role of patient gratitude on the connection between relationship quality and patient loyalty.

The results of our study showed that satisfaction, trust, and commitment contribute to patient loyalty via patient gratitude. In other words, patients perceive a higher level relationship quality (satisfaction, trust, and commitment) from the healthcare provider in the treatment procedure will translate their perceptions into a positive value and thankful experience which in turn increases patient return rates. Hence, this research suggests that potentially relevant factors that cause patient gratitude should be explored in the medical service industry.

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Identifying Critical Demographic Variables that Affect the Chinese Version of the Safety Attitudes Questionnaire in a Regional Teaching Hospital in Taiwan

Yii-Ching Lee[1], Chih-Yi Chi[2], Chih-Hsuan Huang[3], Hsin-Hung Wu[4]

[1] Office of Dean, Cheng Ching General Hospital – Chung Kang Branch; The School of Health Policy and Management, Chung Shan Medical University; Department of Health Business Administration, Hung Kuang University, Taichung, Taiwan
yiiching.lee@gmail.com

[2] Department of Business Administration, National Changhua University of Education, Changhua City, Taiwan
zzz120422@gmail.com

[3] School of Business Administration, Hubei University of Economics, Wuhan City, Hubei Province, China
tititacer@163.com

[4] Department of Business Administration, National Changhua University of Education, Changhua City, Taiwan
hhwu@cc.ncue.edu.tw

Abstract. This study aimed to measure patient safety culture and examine the variation among the different professions of healthcare workers with diverse demographic variables. A cross-sectional design employing Chinese version of safety attitudes questionnaire in 2015 and self-reported questionnaires were utilized in the current study, administered to all medical staffs at a regional teaching hospital in Taiwan. Descriptive statistics and linear regression with forward approach were applied for analysis based on SPSS. All questions in the questionnaire are classified into eight dimensions. In general, experience in position, supervisor/manager, and age are important demographic variables to affect dimensions.

Keywords. Patient safety culture, Chinese version of safety attitudes questionnaire, Linear regression, Demographic variable.

1. Background

Medical errors are common in healthcare organizations on account of a defective system or human negligence. These adverse events have been recognized as a significant threat to patient safety and the quality of provided healthcare [1]-[3]. National Patient Safety Agency in England advocated that healthcare organizations are supposed to establish "patient safety culture" which focuses on detecting, lessening and preventing harm to patients [4], [5]. Assessing the existing patient safety culture would provide a valuable message for creating the culture [6]. In order to meliorate the healthcare quality, various measures have been created for measuring the patient safety culture. The safety attitudes questionnaire (SAQ) of Sexton et al. possesses good psychometric properties for healthcare workers in many settings [7], [8].

SAQ is recommended as one of three effective tools to be used in patient safety assessment by the European Network for Patient Safety [8]. In addition, the validity and reliability of SAQ has been proved in studies [8]-[14].

Some studies with respect to the patient safety culture assessment on healthcare providers reveal that different demographic information may cause different perceptions of patient safety. A research from Abdou and Saber conducted among nurses demonstrated the nurses who work in intensive care units had slightly highest mean score of the overall safety culture dimensions as compared to those work in coronary care unit [4]. Lee at al. [15] verified the physicians and nurses with different demographic variables perceive differently emotional exhaustion in terms of nine questions from the 2014 internal surveyed data based on the Chinese version of SAQ in their research. Besides, less attention has been paid to other team workers of the healthcare organizations. Thus, it may be advantageous to examine the perceptions of other healthcare providers with different demographic characteristics toward patient safety culture. This study is conducted at a selected regional teaching hospital and applies linear regressions with forward approach to observe how different demographic information influences the perceptions of patient safety culture.

2. Literature Review

2.1 Patient Safety Culture

Healthcare services are tended to deliver patient care in complex surroundings. Risks of medical errors tend to be raised in such circumstances and sometimes cause unintentional harms to a patient. Healthcare organizations in several countries have undertaken the issues of patient safety since 1990s. With the rapidly changing environment in healthcare, patient safety has become more vital in health policies and health practices in recent years [4]. Several international organizations such as the Institute of Medicine (IOM) and the Joint Commission encourage healthcare organizations to assess patient safety and to reinforce medical quality through safety culture surveys.

Patient safety culture is "an integrated pattern of individual and organizational behavior, based upon shared beliefs and values that continuously seeks to minimize patient harm, which may result from the processes of care delivery" defined by the European Society for Quality in Health Care [16]. The above definition reflects a hospital with a better patient safety culture shows the lower number of adverse hospital events and also manifests in prior researches. The study conducted by Ulrich and Kear [17] has shown the high level of patient safety has a positive influence on assessments of care by patients. Nieva and Sorra [18] also claimed that a positive safety culture recognizes the inevitability of errors and proactively seeks to identify latent threats.

2.2 Safety Attitudes Questionnaire

The SAQ developed by Sexton et al. [9] in 2006, a model based on six dimensions of healthcare provider attitudes, has been widely utilized across many hospitals. The validity and reliability of the SAQ have been documented in previous studies. For instance, the Chinese version of the safety attitudes questionnaire (SAQ-C) used in Taiwanese hospitals has also been verified with good psychometric properties of SAQ [15]. SAQ was derived from flight management attitudes questionnaire (FMAQ). Twenty five percent of FMAQ items are retained on the SAQ because they demonstrated utility in medical settings [9]. The six dimensions are: teamwork climate (perceived quality of collaboration between personnel), safety climate (perceptions of a strong and proactive organizational commitment to safety), perceptions of management (approval of managerial action), job satisfaction (positivity about

the work experience), working conditions (perceived quality of the work environment and logistical support), and stress recognition (acknowledgement of how performance is influenced by stressors) [19], [20].

Taiwan Joint Commission on Hospital Accreditation developed the SAQ-C by using the forward and backward translation to examine the quality of the translation. The intelligibility and item applicability of the questionnaire was deliberated by an expert panel [19], [20]. Taiwan Joint Commission on Hospital Accreditation modified the original questionnaire from six dimensions and 30 questions to nine dimensions and 41 questions by considering from Agency for Healthcare Research and Quality. Three dimensions were integrated into the questionnaire that includes hospital management support for patient safety, teamwork across hospital units, and hospital handoffs and transitions [19]. The latest version of SAQ-C in 2014 retained the six dimensions of original SAQ from Sexton et al. and combined two new aspects with nine and seven questions items, respectively, which are: emotional exhaustion and work-life balance.

3. Research Method

A quantitative, descriptive, and cross-sectional design employing self-reported questionnaires was utilized so as to assess patient's safety culture from medical staffs' perspective at a regional hospital. The study was conducted in a teaching hospital located in the central region of Taiwan in 2015. The teaching hospital has a bed capacity of 700 with all major medical specialties and services. All professional groups working in this hospital were invited to participate in the study, including physician, nurse, technician, pharmacist, medical administrator, respiratory therapist, and others. The demographic questions in terms of gender, age, supervisor/manager, job position, job status, experience in organization, experience in position, education, and direct patient contact are included in the survey. The number of the final valid questionnaires is 618.

The data for the study were collected by the version of SAQ-C in 2015 which consists of 46 items that examine medical staffs' attitude toward eight dimensions: teamwork climate, safety climate, job satisfaction, stress recognition, perception of management, working condition, emotional exhaustion, and work-life balance. All responses were recorded using a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. Not all of the staffs have to fill out the entire questions when answering the Chinese version of SAQ. For instance, physicians and nurses are required to fill out forty six questions. For technicians, question items 2, 4, 6, and 33 are not required, and the number of questions is forty two. For pharmacists, question items 2, 4, 6, and 33 are not necessary, and the number of questions is forty six. For medical administrators, question items 2, 3, 4, 6, 8, 30, and 33 are not required, and the number of questions is thirty nine. For respiratory therapists, only question item 6 is not required. Finally, for others, question items 2, 3, 4, 6, 8, 30, and 33 are not necessary, and the number of questions is thirty nine. For the sake of measuring the patient safety culture from all the staffs, we adopted the coherent questions among different professions. Individual questionnaire responses were aggregated by calculating the score of the items for each dimension.

After completing the data collection, data are exported into the file type suitable for analyses by SPSS software (Version 18). Analysis of collected data was performed through the use of linear regression analysis with forward selection. This technique allows us to predict the dependent variables from the predictors, so that we can observe the interaction between independent variables.

4. Results

Descriptive statistics of the demographic characteristics of respondents were computed. According to the demographic figures, 80.9% of the total respondents are female and around half are nurses (54%). The respondents' age ranged between 21-30 (34.6%) and 31-40 (36.6%) years old. The majority of the respondents has the full time job (90.8%) and has college or higher degrees (94.7%) in this teaching hospital. More than 60% of the respondents have reported the events during the past twelve months and 74% of them often have the contact with patients directly.

The results of using linear regression with forward selection based on eight dimensions are summarized in the respective tables (Tables I-VIII). The R-square values are from 0.042 to 0.131. Three of variables, the employees who are in charge of supervisors/managers, with less experience in position, and elderly staffs, show the significance of affecting the eight dimensions of SAQ. Employees who are supervisors/managers have better perceptions in teamwork climate, safety climate, job satisfaction, perception of management, and working condition, excluding stress recognition. Employees with less experience in position tend to have higher satisfaction in teamwork climate, safety climate, job satisfaction, stress recognition, perception of management, working condition, and emotional exhaustion apparently but except in work-life balance. Besides, elderly employees tend to have higher satisfaction in job satisfaction, perception of management, working condition, and emotional exhaustion, aside from stress recognition.

Table I. Results of teamwork climate by linear regression

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	10.558	.462		22.830	.000
Supervisor/ Manager	-1.369	.212	-.258	-6.468	.000
Experience in Position	-.109	.037	-.118	-2.947	.003

R-Square = 0.067; adjusted R-Square = 0.064

Table II. Results of safety climate by linear regression

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	29.676	1.297		22.873	.000
Supervisor/ Manager	-4.410	.535	-.323	-8.246	.000
Experience in Position	-.279	.094	-.116	-2.974	.003
Direct Patient Contact	.552	.242	.087	2.286	.023

R-Square = 0.106; adjusted R-Square = 0.101

Table III. Results of job satisfaction by linear regression

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	24.262	1.338		18.133	.000
Supervisor/ Manager	-3.861	.550	-.282	-7.025	.000
Age	1.042	.204	.236	5.119	.000
Experience in Position	-.508	.109	-.213	-4.646	.000

R-Square = 0.131; adjusted R-Square = 0.127

Table IV. Results of stress recognition by linear regression

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	14.793	1.746		8.472	.000
Supervisor/ Manager	.789	.373	.092	2.117	.035
Experience in Position	-.260	.085	-.125	-3.053	.002
Direct Patient Contact	-1.183	.469	-.106	-2.519	.012

R-Square = 0.049; adjusted R-Square = 0.044

Table V. Results of perception of management by linear regression

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	12.546	1.227		10.223	.000
Supervisor/ Manager	-1.770	.323	-.238	-5.479	.000
Experience in Position	-.240	.057	-.184	-4.199	.000
Age	.609	.234	.107	2.600	.010
Education	.236	.109	.099	2.175	.030

R-Square = 0.108; adjusted R-Square = 0.102

Table VI. Results of working condition by linear regression

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	14.479	.745		19.424	.000
Supervisor/ Manager	-1.990	.306	-.267	-6.499	.000
Experience in Position	-.271	.061	-.208	-4.452	.000
Age	.299	.113	.124	2.633	.009

R-Square = 0.090; adjusted R-Square = 0.085

Table VII. Results of emotional exhaustion by linear regression

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	24.463	.876		27.935	.000
Job Position	.398	.146	.108	2.721	.007
Age	1.199	.303	.189	3.950	.000
Experience in Position	-.509	.163	-.148	-3.123	.002

R-Square = 0.042; adjusted R-Square = 0.037

Table VIII. Results of work-life balance by linear regression

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	19.876	.798		24.906	.000
Supervisor/Manager	.577	.105	.213	5.474	.000
Experience in Position	.818	.313	.105	2.615	.009
Direct Patient Contact	-.572	.264	-.085	-2.167	.031
Experience in Organization	-.222	.103	-.088	-2.167	.031

R-Square = 0.078; adjusted R-Square = 0.072

5. Conclusions

It is needed to identify determining characteristics which will affect the patient safety culture and to have an improvement for specific clinical units. The aim of this study is to evaluate the perceptions of patient safety culture of medical staffs. We found out that supervisor/manager and experience in position are strongly in relation to patient safety culture from the assessment of this teaching hospital. Employees who are in charge of supervisors/managers perceive better patient safety culture than other groups in general. Employees with less experience in position tend to have higher satisfaction of patient safety culture. Differences of age also report various attitudes toward these eight dimensions.

6. Acknowledgement

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Use of ICT in Teaching at University Level: A Qualitative Perspective of Teachers

Joel Angulo Armenta[1], Carlos Arturo Torres Gastelú[2], José Luis Soto Ortíz[3], Karen Michelle Olivares Carmona[4], José Raymundo García Cano[5]

[1] Department of Education, Technological Institute of Sonora, Sonora, Mexico
joel.angulo@itson.edu.mx

[2] Faculty of Management, Veracruzana University, Veracruz, Mexico
ctorres@uv.mx

[3] College of Veracruz, Veracruz, Mexico
jlso.uv@gmail.com

[4] Department of Education, Technological Institute of Sonora, Sonora, Mexico
kolivares4619@alumno.itson.edu.mx

[5] Veracruzana University, Veracruz, Mexico
raygarcia@uv.mx

Abstract. This document shows the beliefs of Mexican university professors hold in relation to the use of ICT in teaching. A non-probabilistic sample was used, carrying out interviews and surveys in a university located in Sonora. The evidence indicates that the professors interviewed considered ICT to be facilitators in the teaching process and believing that ICT improve the communication process among educational actors. On the other hand, obstacles for adopting ICT are the lack of formation in the field, age and unfamiliarity with their use. Even do these professors feel competent in the use of these technologies

Keywords. ICT, Information and Communications Technology, teaching, University, Teachers.

1. Introduction

The present study was carried out at a public university in southern Sonora, Mexico, which has always been known for being innovative and avant-gardist in the use of ICT in its teaching and learning processes. At present new technologies are integrated into the system and the faculty is perceived as tech-competent (Angulo et al., 2014). There are many classrooms with computer equipment and projectors, computer labs and Internet access in all campuses. Professors use these resources in their classes and give classes using their own digital didactic material, be it virtual combined with classroom, totally virtual or as support material in the classroom.

Given the frequent use professors make of ICT in teaching at our university, it is not uncommon for the professor to see it as a natural process to which he/she has had to adapt. There has been a lot of unrelated speculation about this phenomenon, ranging from support from outside the school, such as educational policies for providing educational centers with technology, to much more support such as the educational belief or meaning of ICT in teaching, there being technological conditioning and influence in society producing a strategy of believing that the presence of ICT should be linked to strategic speeches which would guide

and justify the significance of its use in teaching.

In the face of this panorama and based on the beliefs in the meaning that the faculty holds on the use of ICT in teaching, this study examined some of the variables of interest which are: a) its influence on teaching, b) its uses in education, c) the aspects which favor or hinder the use of the new technologies, d) the criteria for broadening and improving its use in pedagogic practices, and e) the benefits of possessing technological competence.

The following question is the result of these variables. What are the beliefs on the meaning the university professor has for these variables which may favor or hinder the use of the new technologies in teaching?

The objective of this study was to understand the meaning the university professor gives to those factors which favor or hinder the use of ICT and which are related to teaching; and specific objectives were 1) Describe the perception of ICT in teaching held by university professors, 2) Analyze the perceptions the faculty has in relation to the variables which hinder the use of ICT in teaching, 3) Analyze the perceptions the faculty has in relation to the variables which favor the use of ICT in teaching, y 4) Discover the perceptions of the faculty in relation to the factors which hinder or favor the use of ITC in teaching, and the research question of this study was What are the meanings which the new information and communication technologies hold for university professors, resulting from the use by these professors of ICTs in their teaching?

2. Concerning Theory and Background

The use professors make of ICT in teaching may have different meanings depending on the context in which they are used. Adopting ICT in teaching is an important factor in professors' assuming reflection and analysis of their potential. However, most professors have not formally integrated ICT into their teaching. Up to the present, the process of integration has been due to the professors needs for working with ICT in order to improve their teaching strategies and keeping up with new technologies, albeit superficially and technically, which has not led to improved results in students' performance as was the hope in the second wave at the beginning of the 90s (Boza, Tirado & Guzmán-Franco, 2010). Some studies with outstanding results on the beliefs and meanings of ICT in teaching held by university professors were made by Andrade (2014); Briceño and Benarroch (2013); Boza et al. (2010); Riascos-Erazo, Quintero-Calvache and Avila-Fajardo (2009); Barros, Cavaría and Paredes (2008); and Acevedo, Vázquez, Acevedo and Manassero (2002).

Some of the variables which may favor or hinder the use of ITCs in teaching are those related to infrastructure, leadership of the principal, organization of the school, curriculum and teacher-related aspects (Angulo, Torres and Valdés, 2013). With respect to the professor, we live in an information and communication society in which education is traditional and the role played by the professor is irreplaceable, even though the use of ICT in education has increased. Some factors which may negatively influence the appropriate use of new technologies by professors are: a) not having pedagogic formation in the use of ICT, b) the lack of technological and digital competence and c) not adopting a positive attitude towards adopting ICT in teaching.

With respect to the first aspect, teacher training, today we are immersed in an educational system which has historically been traditional and which requires special preparation of teachers in the new methodologies which will transform the classroom into a scenario mediated by new technology. The integration of ICT into teaching is a process of adaptation, making it important to identify whether the teacher is using it as support for his/her teaching or as a didactic means and resource to achieve objectives. The latter is an indicator of technological competence and of changes in teaching methodology and therefore teacher

training in the use of ICT seeks to produce professors who are autonomous, efficient, responsible and critical in their use of ICT. Pedagogical training in ICT use must be constant and permanent and must have the objective of providing teachers with the digital knowledge and abilities necessary for teaching and not only train them in the habitual use of ICT.

Studies on competence in the use of ICT in teacher teaching (Angulo, Mortis, Pizá and García, 2012; Trigueros, Sánchez and Vera, 2012; Angulo et al. 2011) show low levels of ICT use in teaching due to the low levels of digital competence and lack of evaluation of the training that does exist with respect to the use of ICT in pedagogical practice. However, those professors evaluated aver that they are more technologically competent in the knowledge and functional use of equipment and informatics programs for developing educational processes, as well as in searching for, gaining and processing information.

3. Methodology

- Type of study. A qualitative study with a phenomenological perspective was carried out. Creswell (2014) established that phenomenological studies accomplish a detailed description of the meanings individuals place on various aspect of their lives, with the understanding that these aspects influence the way in which people live and act in certain roles they play in life.

- Participants. A non-probalistic sampling was used. Theoretical saturation reached a total of 20 in-depth interviews and 40 surveys which included questions on the areas of interest. For the interview 10 full-time professors and 10 teacher's assistants were chosen; and for the surveys 20 full-time professors and 20 teacher's assistants were chosen. The key informants were chosen based on their similar profiles of giving courses (experts) in computing centers or at least using ICT (test-case) as a didactic digital resource in teaching within the university of our study.

- Techniques**.** In order to obtain a solid description of the meaning professors assign their subject of research, in-depth interviews and surveys were used. To determine the validation of the content, previously they were subject to the judgment of experts in educational technology and the use of digital didactic resources in conventional and non-conventional spheres.

- Validation of the study. Full understanding of the problem and the results, as well as the validation and credibility of the study, were reached through the triangulation of the techniques implemented, rating the content by expert researchers and the various participants having similar profiles involved.

- Procedure for data collection. In a first instance, consent of the professors was sought for access to the field of study, previously explaining the purpose and benefits of the results to each; finally total confidentiality was guaranteed.

4. Results

Topic I. Beliefs held by university professors in relation to the use of ICT in teaching

The university professors perceive the use of ICT in teaching in accordance with two essential elements: a) ICT as communication tools, and b) ICT as facilitators in the teaching-learning process. Taking into account these two elements, they think of ICT in pedagogic practice as a novel tool which makes the teaching practice easier.

Interview 19**:** "They mean innovating in our classes, our teaching methods and learning for you [sic]. It is the use of new sources, new tools, to enrich our classes."

Survey 1: "They are an indispensable tool, in the classroom, as well as for communicating."

Survey 7**:** "They are tools which make the teaching-learning process easier and which

adapt to the needs of time and space."

Topic II. Perception on how ICT influence teaching practices.

The teachers perceive the use of ICT in teaching favorably since they help in planning the class, in communicating, presenting and offering information to students.

Interview 6: "They are a positive influence since you are in direct contact with the student because we can communicate via computers."

Interview 17: "They influence when they have to search for information, write papers, they do have a great impact on the development of my students."

Survey 5: "They are deciding factors in planning my courses."

Survey 12: "They improve the communication and dissemination of information between teachers-students."

Topic III. Perceptions on the uses they may give ICT in education.

Professors think of ICT in education in various ways. They connote the terms education and learning. Their perception focuses on digital didactic resources, class design, strategies for teaching and research.

Interview 7: "They can be as platforms, the creation of virtual classes, the creation of tools, didactic materials, as learning objectives. They could even be for designing different activities for developing strategies within the process itself."

Survey 1: "They are very diverse, as audiovisual, research, writing aids, studying technical programs, etc."

Survey 7: "Designing courses, evaluating learning, giving courses and research."

Topic IV: Perception of the factors hindering the use of ICT by the teacher.

The answer for teachers about for perception concerning factor hindering the use of ICT in education were grouped in three categories: a) lack of training and update, b) the resistance change, and c) 'fear'and lack of access and resource (Fig 1).

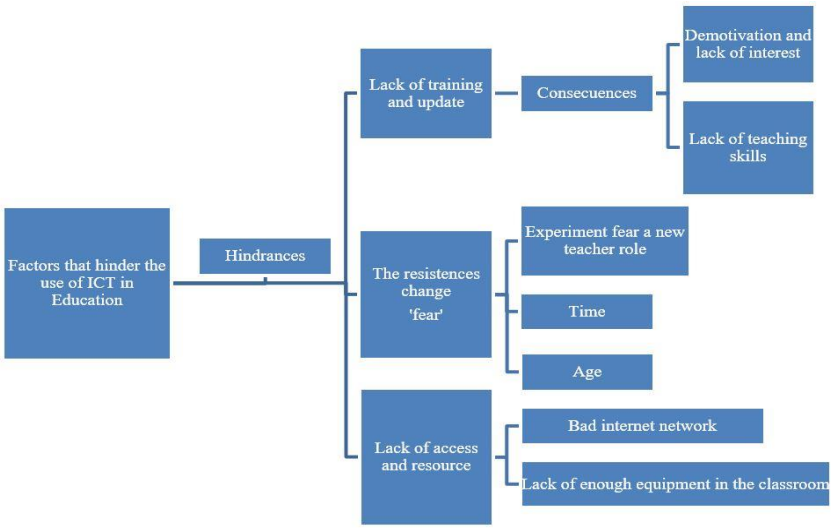

Fig. 1. Perception of the factors hindering the use of ICT by the teacher.

Lack of teaching: In this category teachers responses are grouped into demotivation and lack interest, as also mentioned the lack of teaching skills that can occur due to a lack of training and update e their teaching.

Survey 1:The lack of budget in educational institutions, lack of training in certain technology.

Interview 17: "Ignorance and lack of training."

Survey 11: The lack of knowledge of available technologies to support education resistance to change "fear" This category three characteristics, fear of experiencing a new teaching role, time and age were pooled. In some cases they prefer to keep the comfort of the methods through their careers have been used because they feel safe because it has worked.

Interview 20: "The factors that hinder teachers from I think the resistance ..."

Survey 2: The lack of access to resources, lack ICT or resistance to technology.

Survey 8: Fear to change or illiteracy (sic) Technology".

Survey 17: "Ignorance and not trained to use them for the same age."

Survey 10: Lack of training, access and time to develop learning objects lack of access and resource here the responses from teachers regarding their perception they were doing evil systems and Internet networks and to the lack of equipment in the classroom considering them as obstacles

Survey 4: "I do not have internet in the classrooms"

Interview 7: A bad system networks or internet or damaged technical equipment and lack of training of teachers for the use of ICT.

Survey 17: Lack of internet in every classroom of the institution, more training, and the institution pays certain rights to use certain programs.

Topic V: Perception of the factors that favor increased use of ICT by the teacher.

Regarding the factors that favor the use of ICT in education, teacher perception is oriented towards the resources that exist in the entire University study, earning categories; motivation, communication and update (Fig 2).

Motivation: Search perception of teachers as to the factors favoring lies in acquiring skills; where they are implemented innovative strategies and presented in a better way the contents in class.

Survey 7: Promotes the content of a self- regulating manner with the student.

Interview 6: Contagion to see other teachers use them, self-learning, use of tutorials on how to make materials online courses offer you more personalized.

Survey 19: In certain areas often requires classes and illustrate the use of the technologies is very favorable.

Survey 1: Teacher education, training, etc. Better communication in this category teachers perceive ICT as favorable allowing better communication between student-teacher.

Survey 8: The advantages of asynchronous and synchronous provide support for apprentices.

Interview 19: That can better explain the practical classes update search the responses of teachers was characterized to innovation, obtaining as favorable factors in the use of ICT equip classrooms for better internet access, technology platforms and free software.

Interview 1: "The platforms of information, access to technology and especially refresher courses are very important."

Survey 3: "The existence of (sic) technology platforms in college, laptop, internet, etc.".

Survey 4: "Having internet in college."

Survey 12: "Infrastructure and training that we provide."

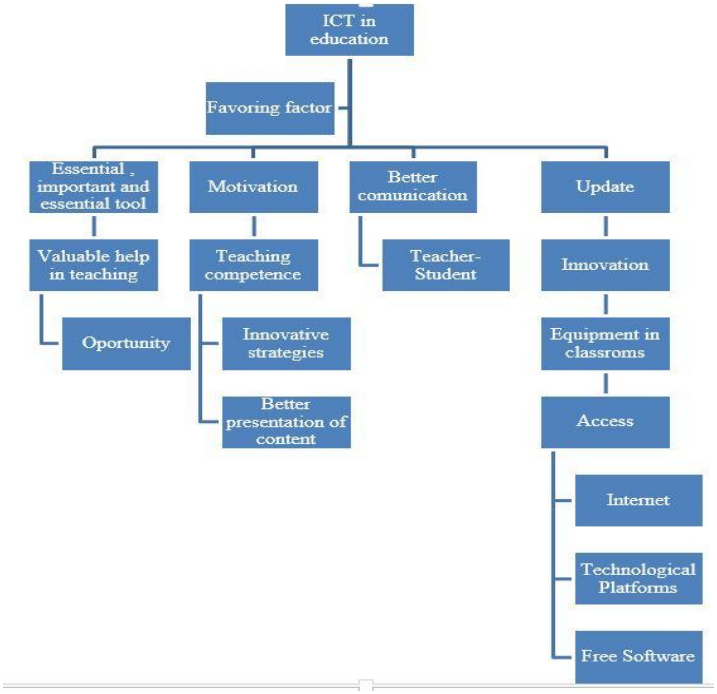

Fig. 2. Perception of the factors that favor increased use of ICT by the teacher.

Topic VI: Perception as to the benefits of being proficient in the use of ICT to develop teaching.

The teacher appreciates competent from the need to be updated and trained in the use of ICT in education, this is how established a better quality in their work, streamlines the class, strengthen the teacher - student relationship, it is innovative when using new teaching strategies achieving meaningful learning in students.

Interview 18: "I say it is profit to be more creative , more innovative , that's what I think more could be the benefits you may have with the teacher, the use of new teaching and learning strategies that may also favor in the process and that students learn more with the media. "

Survey 3: "We can be more (sic) empathetic with youth and also other ages that can change their education."

Survey 11: "Improving the quality of your work, and speeds up the work of making educational materials."

Analysis

The object of the present research constitutes a psycho-social phenomenon, since it is the beliefs and meanings the professors give ICT in the process of teaching. The teacher, the main actor in university teaching, bases his/her beliefs and actions on the meaning which he gives to things within his context. He believes that it is here where he builds meanings based on the social interactions he lives. However, this space also influences him/her, making him or her reflect and make decisions which modify the meaning based on the interpretive process which he may carry out as a thinking, intelligent subject.

The results show that university professors who participated in this study believe that the use given to ICT in teaching is a novel tool which facilitates communication, teaching and

learning processes. This in part is in keeping with Barros, Cavaría and Paredes (2008), who considered the role played by ICT in the teaching-learning process relevant in areas such as better quality, dynamics, and enrichment of communication and depth of learning, among others. This point of view may be related to the constant use each professor makes of new technology in the classroom, although this practice does not guarantee quality teaching. Its integration depends on multiple factors such as training, curriculum, planning and carrying through, infrastructure and equipment, Internet quality, the professor's attitude, technological and digital competence, and media and information literacy, among others.

With reference to the influence of ICT on teaching practices in which the opinion of the university professors focuses on planning, presenting information and communication, the outcome found by Andrade, Bozo and Cendrós (2011) show results related to the present investigation since the professors think that implementing new technology is necessary and they say that they would never refuse to use ICT in their academic activities. No doubt the use of ICT somehow integrated into the curriculum has led teachers to systematize and administer their activities both inside and outside of the classroom. With reference to the findings related to the use of ICT in education, professors perceive these to be digital didactic resources, for planning classes and strategies of teaching and research. The use of ICT in the educational context should not be based merely on technical and pedagogic change, but also adapt itself to new technological proposals, link them to didactic research and access to these, although the latter is a recent pedagogical revolution with new paradigms in the art of teaching (Díaz-Barriga, 2013; Pérez and Salas, 2009). One of the main duties of university professors is research, making it apparent that new technology, at least at the university of our study, is used, among other things, to produce, apply and spread scientific knowledge.

With respect to factors which hinder the use of ICT by professors, this may be attributed to a lack of training in the use of ICT, resistance to change, age and unfamiliarity, which produce uncertainty and a lack of technological competence. Other factors which influence the use of ICT in classrooms equipped with technological devices are: pedagogical adjustment and usefulness, support for the teacher, availability and access in the classroom, and technological competence (Badía, Meneses and Sigalés, 2013). On the factors which promote greater use of ITC by professors we find that these focus on the availability of resources at the university of our study, for example Internet access, technological platforms, free software, workshops on ICT and equipment in the classroom; there is also the added motivation of electronic communication with students. The factors which favor good ICT practices by professors in the classroom are related to their integration and innovation (Colás and Casasnova, 2010), which is necessarily closely linked to the professor's personal and professional context. Finally, the professor feels he/she is competent if he/she has had training and refresher courses in the use of ICT in teaching, and this in turn is reflected in benefits in the quality of his/her work, strengthening teacher-student communication, and mastering and implementing innovative strategies aimed at significant learning by students.

Notable coincidences of this study with the contributions of Vergara (2005) were found, specifically in the difficulty for the researcher in differentiating the borders between meanings, beliefs and knowledge of the professors who participated. There was also coincidence in the meanings given to the use of ICT in the process of teaching, in relation to the process of formation of those interviewed since the age they gave during the interview showed that some were trained in the ICT sphere while others were not.

5. Conclusion

Never before has a professor's job been so complex, presenting so many opportunities and challenges (Pedró, 2004). The objective of this study was to understand the significance

that the university professor places on those factors which facilitate or hinder the use of ICT and which are related to learning. Undoubtedly the university professor's indiscriminate use of new technology in teaching plunges him/her into the practical and novel meaning, at the same time, it leads him/her to think that the process of integration and thus significant learning by the student has been reached. It is clear that the professors who were interviewed use ICT in the teaching process, they think of them as facilitating tools for teaching; they acknowledge the importance of incorporating them into the curriculum and the classroom. Moreover, technology improves communication between educational actors. However they also perceive that there are obstacles in adopting ICT due to their own lack of formation in the field, their age and unfamiliarity of their use; all of these factors empower the professor who manages to use ICT, giving him/her a sense of innovation and competence in the use of ICT in his/her teaching.

The increase in the use of ICT as support for traditional teaching and in non-classroom circumstances should be conditioned so that professors, in the first place, think about the variables which affect their being incorporated into the classroom or not; this because formative processes have changed and will continue to change; and secondly being technologically competent is not enough. The digital competence of professors is another matter which is pending, since beyond the basic use of technology and conventional programs there are five other important elements. These are: 1) Media and information literacy, 2) technological and information competency, 3) multiple literacies, 4) generic cognitive competency, and 5) digital citizenship (Adell, 2012).

Finally, in this phenomenological study we learn some of the beliefs which university professors have on the meaning of the use of ICT in teaching, thus contributing, even taking into account the limitations of the study, evidence to this complex object of study, meanings. Despite answering the questions presented, there are still doubts on the line of investigation which may help researchers make more in-depth studies of this kind:

What meanings do you give to media informational, digital and technological competences in teaching using ICT?

What meanings do university professors give to the school context?

How do training and refresher courses in ICT affect the meanings university professor have?

What other variables or elements should be included in research of this type in order to discover the meanings given by teachers to the use of ICT in their teaching?

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Internet Usage Habits in Young Provincial University

José Luis Soto Ortiz[1], Carlos Arturo Torres Gastelú[2], Elida Cruz Sánchez[3], Joel Angulo Armenta[4] .

[1] College of Veracruz, Veracruz, Mexico
jlso.uv@gmail.com

[2] Faculty of Management, Veracruzana University, Veracruz, Mexico
ctorres@uv.mx

[3] College of Veracruz, Veracruz, Mexico
esanche@alumni.uwo.ca

[4] Department of Education, Technological Institute of Sonora, Sonora, Mexico
joel.angulo@itson.edu.mx

Abstract. This paper presents the results of a study are presented on the Internet usage habits of university students in the province of Tres Valles, Veracruz and surroundings. The objective was to determine the general habits, patterns of use and applications used. The type of study is descriptive cross applied in April 2016, the sample consisted of 73 university students and the age range is 19 to 30 years. For data collection, a printed questionnaire was applied and the responses were entered a database using the SPSS 17.0 program. The results indicate that 70.8% connect daily, 64% connect from your cell phone while a 100% use Facebook, 94% WhatsApp. In conclusion, most of the time the students connect to the Internet to maintain communication, it is further noted that overuse of social networks.

Keywords. Internet, social network, higher students, smartphones.

1. Introduction

Since 2010, the use of the Internet in the population has increased in Mexico from 28% to 50%, per data from the AMIPCI (2015) points out that in Mexico there are 65 million Internauts, of which 3.9 million (6%) correspond to the southern part of the country. As for the state of Veracruz, the INEGI data (2016) indicate that there are 2.24 million Internet users, being the fourth entity with more cybernauts nationwide. This represents a 15% growth over last year. So, the use of the Internet has changed the way people interact and interact, previously it was enough to make a telephone call to make contact.

Now only required with access to a mobile application to have communication with family or Friends. It is undeniable that the widespread use of new information and communication technologies has transformed communications between people in the world today, which is especially relevant in the case of the younger. Internet browsing, social networking, video games and mobile phones have led to a radical change in the ways of socializing for most of them.

The Internet offers young people new opportunities for learning, along with the possibility of horizontal information exchange. Per Reolid-Martínez et. al (2016) they argue that, in adolescence, the search for immediate gratification and curiosity converge for new experiences with a feeling of invulnerability, so that adolescents are more exposed to risky behavior. On the other hand, Graner et. al (2007) point out that the Internet being a mediation

channel and not the message can increase certain addictive behaviors, such as: online games, betting, sex or shopping.

This is because the Internet is much more than a technological object, it is a cultural practice and a movement of transformation affecting the different dimensions of a society (Cabrera, 2001). Within some of the dimensions are: the social, cultural, economic and political aspect that detonate the current technologies of information and communication. This document intends to indicate lines of investigation in the sense of describing the habits of the use of the Internet in young university students of the province of Tres Valles, Veracruz and its environs.

2. Concerning Theory and Background

Today, excessive use of the Internet prevails, it is very common to see people using their mobile devices (cell phones, tablets and personal computers). In this regard, some researchers have studied whether there is an addictive behavior in people to stay connected, and if certain people perform these actions in a similar way to the behaviors and experiences of those who are addicted to drugs (Graner et. al, 2007). These excessive repetitive and habitual behaviors lead to what is known as a behavioral addiction. Behavioral addictions also occur in everyday activities such as shopping, work, sex, betting, video games and sports (Alonso, 2003, Bernete, 2009, Echeburúa, 1999 and Gonzalez, 2005). Madrid (2000) argues that the concept of addiction is linked to abuse in the use of chemical substances such as drugs.

Behavioral addictions also occur in everyday activities such as shopping, work, chats, video games and sports (Alonso, 2003, Bernete, 2009, Echeburúa, 1999 and Gonzalez, 2005). Madrid (2000) argues that the concept of addiction is linked to abuse in the use of chemical substances such as drugs. However, psychological or non-chemical addictions are included in the statistical manual of mental disorders (DSM-V) but do not refer to an addiction to the Internet as such.

In this regard, several authors have investigated habits in the use of the Internet, referring to the time spent on browsing, used applications, accessed websites and online games to determine the levels of youth and internet consumption (Albero, 2007; Sarena, 2006), as well as Internet usage patterns in university students (Romero et. al, 2000), pointing to the possible "abuse" of Internet becoming in an addictive problem. Other authors have analyzed in a generic way the use of the Internet in university students, distinguishing between the different uses and tools offered by the Network (Espinar and González, 2015).

For its part, Sarena (2006) argues that thinking about the habits acquired by young people in the management of the Internet implies making certain analyzes about how they have built their ways of relating and linking in these virtual spaces by fostering interaction and exchange with Other young people; since this experience lived and shared forces to make investigations of the habits of the use of the Internet. However, not everything points out that the Internet is the only artifact by which young people connect, the mobile phone is also.

Meanwhile Salas (2014) points out unconventional addictions, such as technological addiction, cell phone addiction and addiction to social networks. Probably the greatest risk of excessive use of the cell is the possibility of generating an addictive behavior, this addiction is more likely to be generated in adolescence than in the adult, because its prefrontal cortex is still immature and its Self-control has not reached the adult level (Oliva, 2007).

People who use a smartphone often have programs that allow them to store and share information, such as: email, messages, social networks (Facebook, twitter, etc.), Internet browsing, camera for photos and video, which Has become as an extension of the person and hardly separated from the cell. As it is appreciated, the dependence on technologies is

increasing, although the gap of space and time has been reduced, also comes to light to know the habits that are acquiring from the constant access to Internet.

3. Methodology

- Type of study. Exploratory study of quantitative type.
- Participants. A non-probalistic sampling was used. The sample was constituted by 73 university students of the province of Tres Valles, Veracruz and its surroundings and the range of ages were between the 19 to the 30 years. For data collection, a printed questionnaire was applied and responses were entered a database using SPSS software version 17.0.
- Purpose. The objective of this work was to know the habits of Internet use, motives of use and applications used in a group of university students enrolled in the Cuenca Institute of Papaloapan in the town of Tres Valles, Veracruz, Mexico.
- The instrument that was applied was of a quantitative type and is an adaptation of the Internet-related experience questionnaires (CERI). The questionnaire was constituted by 20 items, establishing a Likert scale of four values: determinant, significant, little and null. The instrument was applied in printed form and for the analysis the data were stored and processed with the SPSS statistical software.
- Procedure for data collection. Data were collected during the telephone service workshop in April 2016. The questionnaire was administered by the workshop tutor prior to consensus with the university authorities as well as the participants. The first sheet of the instrument specified that the workshop was voluntary, confidential and anonymous.

4. Results

Based on the results obtained, the population consisted of 56.9% male and 43.1% female. Regarding experiences related to Internet access, there are general connection habits so that 70.8% indicate that they connect daily while 20% connect once or twice a week. The connection time students spend surfing the Internet is 46% more than 3 hours a day, 20% between 1 and 2 hours and 6% less than 1 hour.

The schedule they set to connect is 23% (8 am to 2 pm), 32% (3 pm to 9 pm) and 16% connect from 9 pm. The place from where the analyzed subjects are connected to the Internet is 56% from their home, and 44% from the school network. When questioned the reasons for use the answers indicate that 73.9% is connected to the Internet to access social networks such as Facebook, Twitter, Instagram among others. 26.1% connect to download files, listen to music, watch movies.

About attitudes regarding the use of mobile and Internet, participants point out that more and more people of their age are hooked to social networks 42% agree totally, 37% agree. Likewise, the results indicate that they consider that their friends make excessive or inappropriate use of the Internet and social networks with 40.3% responded totally agree, 38.9% agree. In turn, students think that social networking is a good way to meet people and make friends with 60% totally agree and 40% agree.

Finally, in relation to the excess of time spent on the Internet, 43% agree and 20.8% fully agree, when asked if they have sometimes lost hours of sleep to use the Internet, 29.2% are of Agreement, while 16.7% fully agree. With respect to whether students have neglected their studies and the completion of homework by being connected to the Internet, responses indicate that 46% disagree and 10% agree.

5. Conclusion

Based on the obtained results it is observed that the participants in this study maintain Internet connection through their mobile phone no matter if they are in the school or at home. The motive of connection is mainly due to access to social networks to which they attribute that it allows them to meet people. It should be noted that, per this study, students indicate that staying connected has not negatively influenced their studies and assignments this contrasts with the time that they have been dedicated to being connected whenever they indicate that they have Stolen hours to sleep by surfing the internet

Per the above, it is concluded that the participants present habits of connection to social networks such as Facebook, Twitter, Instagram among others. Likewise, the answers show that, although they connect daily to the Internet, this has not been a factor in leaving their academic and school activities.

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Queueing System with Server Vacations and Exhaustive Service Discipline

Svetlana Paul, Anatoly Nazarov, Alexander Moiseev

Tomsk State University, Tomsk, Russia
paulsv82@mail.ru, nazarov.tsu@gmail.com, moiseev.tsu@gmail.com

Abstract. In the paper, a queueing system with server vacations is considered. Such models are very useful for investigations in the field of polling queueing systems. In this work, we consider a modification of system with vacations when a service discipline is exhaustive and vacations have a general time distribution. Steady-state probability distribution of customers' number in the queue and customers' queue-time distribution are obtained in the paper.

Keywords. Queue with server vacations, Exhaustive service discipline, Polling systems.

1. Introduction and Problem Statement

In telecommunication networks, it is often necessary to transmit urgent information via common communications. These data may be transmitted with a priority or in the background according to the chosen technology. The concept of a background service is a special case of priority one because background applications can have both a lower and a higher priority for maintenance. In this case, the server breaks connection with the mainstream of requests and services background applications. Such systems are called as systems with server vacations [1]. Also, the term "vacation" may be used in meaning of the work associated with server's maintenance or adjustment.

In addition, models with server vacations are widely used as a method of investigation of multi-dimensional and cyclic systems (polling systems) [2]. Usually, study of such systems is performed by using of basis of queueing theory [3] and models of queueing systems and networks [4, 5]. In terms of the theory, such systems orderly polls multiple queues, and the server or multiple servers that are connected to the queue serve the requests in it. In this case, we can consider just one stream of arrivals and its servicing, and "vacation" will refer to the time that the servers spend for servicing of other queues. Therefore, the order of queuing for systems with server vacations is the same as for polling systems. In the paper, we will use the term "customer" as a synonym of the term "request".

Here are the basic disciplines of the servers' connection [6, 7]:

1) Exhaustive service discipline is when the servers handle customers until the queue be empty.

2) *l*-limited discipline is when the servers handle customers until *l* customers be handled or until the queue be empty.

3) *T*-limited discipline is when the servers handle customers during the period with length of *T*.

In the paper, we consider a queuing system with one server with exhaustive service discipline, and a queue with an infinite number of positions. Arrivals are Poisson with rate λ. Service time is distributed exponentially with parameter μ. The server handles customers from the queue until the queue be empty. After that, the server immediately goes to a "vacation".

The duration of vacation is a random variable with cumulative distribution function $T(x)$. During a vacation, the customers arrive in the system and accumulated in the queue but not served. If at the moment when the server comes back from a vacation the queue is empty, the server goes to a new vacation. In other case, it starts to handle customers from the queue including new customers which arrive in the system during the servicing. The servicing is continuing until the last customer from the queue be serviced, then a new vacation starts, and so on.

The goal of the paper is to find a steady-state probability distribution of the number of customers in the system and a steady-state distribution of the queue-time of a customer (time which it spends in the system before its service starts).

2. Probability Distribution of the Number of Customers in the System

Let us denote the number of customers in the system at time t as $i(t)$, the state of the server as $v(t)$, and the length of the period from the moment t until the end of the current vacation (the residual duration of the vacation) as $z(t)$ (just for period of server vacations). We assume that the state of the server v(t) equals to 1 when the server is busy and it equals to 0 when the server is on vacation.

Consider a Markov process which constructed from two multi-dimensional processes: $\{i(t), v(t) = 1\}$ for busy server periods and $\{i(t), v(t) = 0, z(t)\}$ for server vacations period. We will use notations $P_1(i) = P\{i(t) = i, v(t) = 1\}$ and $P_0(i, z) = P\{i(t) = i, v(t) = 0, z(t) < z\}$ for probability distributions of the process.

We can write the following system of Kolmogorov equations for these functions

$$P_1(1) = P_1(1)(1-\lambda\Delta t)(1-\mu\Delta t) + P_1(2)\mu\Delta t + P_0(1,\Delta t) + o(\Delta t),$$

$$P_1(i) = P_1(i)(1-\lambda\Delta t)(1-\mu\Delta t) + P_1(i-1)\lambda\Delta t + P_1(i+1)\mu\Delta t + P_0(i,\Delta t) + o(\Delta t),$$

$$P_0(0, z-\Delta t) = (P_0(0,z) - P_0(0,\Delta t))(1-\lambda\Delta t) + \mu\Delta t P_1(1)T(z) + P_0(0,\Delta t)T(z) + o(\Delta t),$$

$$P_0(i, z-\Delta t) = (P_0(i,z) - P_0(i,\Delta t))(1-\lambda\Delta t) + \lambda\Delta t P_0(i-1,z) + o(\Delta t).$$

This system can be rewritten in the form of the system of differential equations as follows

$$\begin{cases} -(\lambda+\mu)P_1(1) + \mu P_1(2) + \dfrac{\partial P_0(1,0)}{\partial z} = 0, \\ -(\lambda+\mu)P_1(i) + \lambda P_1(i-1) + \mu P_1(i+1) + \dfrac{\partial P_0(i,0)}{\partial z} = 0, \quad i \geq 2, \\ \dfrac{\partial P_0(0,z)}{\partial z} - \dfrac{\partial P_0(0,0)}{\partial z} - \lambda P_0(0,z) + \mu P_1(1)T(z) + \dfrac{\partial P_0(0,0)}{\partial z}T(z) = 0, \quad i = 0, \\ \dfrac{\partial P_0(i,z)}{\partial z} - \dfrac{\partial P_0(i,0)}{\partial z} - \lambda P_0(i,z) + \lambda P_0(i-1,z) = 0, \quad i \geq 1. \end{cases}$$

Let us introduce the characteristic function $H_1(u) = \sum_{i=1}^{\infty} e^{jui} P_1(i)$ and the partial characteristic function $H_0(u,z) = \sum_{i=0}^{\infty} e^{jui} P_0(i,z)$ (here $j = \sqrt{-1}$ is an imaginary unit). Making

a transition to the characteristic functions and summing the first equation to the second one and the third one to the fourth one, we can write the following system of equations:

$$\begin{cases} -(\lambda+\mu)H_1(u)+\lambda e^{ju}H_1(u)+\mu e^{-ju}\left(H_1(u)-e^{ju}P_1(1)\right)+\dfrac{\partial H_0(u,0)}{\partial z}-\dfrac{\partial P_0(0,0)}{\partial z}=0, \\ \dfrac{\partial H_0(u,z)}{\partial z}-\dfrac{\partial H_0(u,0)}{\partial z}-\lambda H_0(u,z)+\lambda e^{ju}H_0(u,z)+\left(\mu P_1(1)+\dfrac{\partial P_0(0,0)}{\partial z}\right)T(z)=0. \end{cases}$$

Let here

$$\mu P_1(1)+\frac{\partial P_0(0,0)}{\partial z}=\pi_0,$$

then we derive

$$\begin{cases} \left[\lambda\left(e^{ju}-1\right)+\mu\lambda\left(e^{-ju}-1\right)\right]H_1(u)+\dfrac{\partial H_0(u,0)}{\partial z}-\pi_0=0, \\ \dfrac{\partial H_0(u,z)}{\partial z}-\dfrac{\partial H_0(u,0)}{\partial z}+\lambda\left(e^{ju}-1\right)H_0(u,z)+\pi_0 T(z)=0. \end{cases} \qquad (1)$$

This system of equations is the basis for the studies below.

It is not hard to show that a decision of the second equation of system (1) is a function

$$H_0(u,z)=e^{\lambda\left(1-e^{ju}\right)z}\int_0^z e^{-\lambda\left(1-e^{ju}\right)x}\left[\frac{\partial H_0(u,0)}{\partial z}-\pi_0 T(x)\right]dx, \qquad (2)$$

where constant π_0 and the derivative at zero $\dfrac{\partial H_0(u,0)}{\partial z}$ are unknown. To find them, let $z \to \infty$ in expression (2). We obtain

$$H_0(u)=\lim_{z\to\infty}H_0(u,z)=\lim_{z\to\infty}e^{\lambda\left(1-e^{ju}\right)z}\int_0^z e^{-\lambda\left(1-e^{ju}\right)x}\left[\frac{\partial H_0(u,0)}{\partial z}-\pi_0 T(x)\right]dx.$$

The first factor in this equation tends to infinity, the second factor in the form of an integral should converge to zero, then it is necessary to be

$$\int_0^\infty e^{-\lambda\left(1-e^{ju}\right)x}\left[\frac{\partial H_0(u,0)}{\partial z}-\pi_0 T(x)\right]dx=0.$$

Therefore, we have

$$\int_0^\infty e^{-\lambda\left(1-e^{ju}\right)x}\left[\frac{\partial H_0(u,0)}{\partial z}-\pi_0 T(x)\right]dx=\frac{\partial H_0(u,0)}{\partial z}\int_0^\infty e^{-\lambda\left(1-e^{ju}\right)x}dx-\pi_0\int_0^\infty T(x)e^{-\lambda\left(1-e^{ju}\right)x}dx=$$

$$=\frac{1}{\lambda\left(1-e^{ju}\right)}\frac{\partial H_0(u,0)}{\partial z}+\frac{1}{\lambda\left(1-e^{ju}\right)}\pi_0\int_0^\infty T(x)de^{-\lambda\left(1-e^{ju}\right)x}=$$

$$= \frac{1}{\lambda\left(1-e^{ju}\right)}\frac{\partial H_0(u,0)}{\partial z} + \frac{1}{\lambda\left(1-e^{ju}\right)}\pi_0\left(T(x)e^{-\lambda\left(1-e^{ju}\right)x}\Big|_0^{\infty} - \int_0^{\infty} e^{-\lambda\left(1-e^{ju}\right)x}dT(x)\right) =$$

$$= \frac{1}{\lambda\left(1-e^{ju}\right)}\frac{\partial H_0(u,0)}{\partial z} - \frac{1}{\lambda\left(1-e^{ju}\right)}\pi_0 T^*\left(\lambda-\lambda e^{ju}\right) = 0.$$

So, we obtain

$$\frac{\partial H_0(u,0)}{\partial z} = \pi_0 T^*\left(\lambda-\lambda e^{ju}\right), \tag{3}$$

where $T^*(\alpha) = \int_0^{\infty} e^{-\alpha x}dT(x)$ is the Laplace – Stieltjes transform of the distribution function $T(x)$. Then, substituting equation (3) in the solution (2), we derive

$$H_0(u,z) = e^{\lambda\left(1-e^{ju}\right)z}\pi_0\int_0^{z} e^{-\lambda\left(1-e^{ju}\right)x}\left[T^*(\lambda-\lambda e^{ju}) - T(x)\right]dx. \tag{4}$$

Let $z \to \infty$ in expression (4), then we find the limit

$$H_0(u) = \lim_{z\to\infty} H_0(u,z) = \lim_{z\to\infty}\frac{\pi_0}{e^{-\lambda\left(1-e^{ju}\right)z}}\int_0^{z} e^{-\lambda\left(1-e^{ju}\right)x}\left[T^*(\lambda-\lambda e^{ju}) - T(x)\right]dx =$$

$$= \pi_0 \lim_{z\to\infty}\frac{e^{-\lambda\left(1-e^{ju}\right)z}\left[T^*(\lambda-\lambda e^{ju}) - T(z)\right]}{-\lambda\left(1-e^{ju}\right)e^{-\lambda\left(1-e^{ju}\right)z}} = \pi_0 \lim_{z\to\infty}\frac{\left[T^*(\lambda-\lambda e^{ju}) - T(z)\right]}{-\lambda\left(1-e^{ju}\right)} =$$

$$= \pi_0\frac{1-T^*(\lambda-\lambda e^{ju})}{\lambda\left(1-e^{ju}\right)}.$$

Thus, we have

$$H_0(u) = \pi_0\frac{1-T^*(\lambda-\lambda e^{ju})}{\lambda\left(1-e^{ju}\right)}. \tag{5}$$

Equations (4), (5) determine the type of partial characteristic functions $H_0(u, z)$ and $H_0(u)$. By using equation (3), the first equation from (1) and a limit transition $z \to \infty$, we can write the expression for the function $H_1(u)$ in the form

$$H_1(u) = \frac{\pi_0 - \frac{\partial H_0(u,0)}{\partial z}}{\lambda\left(e^{ju}-1\right)+\mu\left(e^{-ju}-1\right)} = \pi_0\frac{1-T^*(\lambda-\lambda e^{ju})}{\lambda\left(e^{ju}-1\right)-\mu e^{-ju}\left(e^{ju}-1\right)} =$$

$$= \pi_0\frac{1-T^*(\lambda-\lambda e^{ju})}{\left(e^{ju}-1\right)\left(\lambda-\mu e^{-ju}\right)} = \pi_0\frac{1-T^*(\lambda-\lambda e^{ju})}{\left(1-e^{ju}\right)}\cdot\frac{e^{ju}}{\left(\mu-\lambda e^{ju}\right)}.$$

Now, let us find the partial characteristic function of the number of customers in the system

$$H(u) = H_0(u) + H_1(u) =$$

$$= \pi_0 \frac{1-T^*(\lambda-\lambda e^{ju})}{\left(1-e^{ju}\right)} \cdot \frac{e^{ju}}{\left(\mu-\lambda e^{ju}\right)} + \pi_0 \frac{1-T^*(\lambda-\lambda e^{ju})}{\lambda\left(1-e^{ju}\right)} =$$

$$= \pi_0 \left(1-T^*(\lambda-\lambda e^{ju})\right) \frac{\lambda e^{ju} + \mu - \lambda e^{ju}}{\lambda\left(1-e^{ju}\right)\left(\mu-\lambda e^{ju}\right)} =$$

$$= \pi_0 \left(1-T^*(\lambda-\lambda e^{ju})\right) \frac{\mu}{\lambda\left(1-e^{ju}\right)\left(\mu-\lambda e^{ju}\right)}.$$

Since $H(0) = 1$, then

$$1 = H(0) = \pi_0 \mu \lim_{u\to 0} \frac{1-T^*(\lambda-\lambda e^{ju})}{\lambda\left(1-e^{ju}\right)\left(\mu-\lambda e^{ju}\right)} = \frac{\pi_0 \mu}{\lambda} \lim_{u\to 0} \frac{j\lambda e^{ju} T^{*'}(\lambda-\lambda e^{ju})}{je^{ju}\left(\mu-\lambda e^{ju}\right) + \left(1-e^{ju}\right)\lambda je^{ju}} =$$

$$= \frac{\pi_0 \mu}{\lambda} \lim_{u\to 0} \frac{\lambda T^{*'}(\lambda-\lambda e^{ju})}{\left(\mu-\lambda e^{ju}\right) + \left(1-e^{ju}\right)\lambda} = \frac{\pi_0 \mu}{\lambda} \frac{\lambda T_1}{(\mu-\lambda)} = \pi_0 \frac{\mu T_1}{(\mu-\lambda)}.$$

Therefore, we derive

$$\pi_0 = \frac{\mu-\lambda}{\mu T_1}.$$

Here T_1 is the average duration of vacations. Thus, the partial characteristic functions

$$H_0(u) = \frac{\mu-\lambda}{\mu T_1} \cdot \frac{1-T^*(\lambda-\lambda e^{ju})}{\lambda\left(1-e^{ju}\right)}$$

and

$$H_1(u) = \frac{\mu-\lambda}{\mu T_1} \cdot \frac{1-T^*(\lambda-\lambda e^{ju})}{\left(1-e^{ju}\right)} \cdot \frac{e^{ju}}{\left(\mu-\lambda e^{ju}\right)}$$

completely solve the problem of finding distributions $P_1(i) = P\{i(t) = i, v(t) = 1\}$ and $P_0(i,z) = P\{i(t) = i, v(t) = 0, z(t) < z\}$. This can be performed numerically by using asymmetric inverse Fourier transforms as follows

$$P_1(i) = \frac{1}{2\pi} \int_{-\pi}^{\pi} e^{-jui} H_1(u) du,$$

$$P_0(i,z) = \frac{1}{2\pi} \int_{-\pi}^{\pi} e^{-jui} H_0(u,z) du.$$

3. Probability Distribution of the Queue-time of a Customer

Obtained distribution of the number of customers will allow us to find the probability distribution of the queue-time of a customer.

Consider a customer arrived in the system at a certain time moment *t*. Let $W(t)$ be its waiting time in the system before the moment when a service of this customer starts. This waiting time we call as a queue-time of a customer. We denote the characteristic function of this queue-time time as

$$F(u) = E\left\{e^{juW(t)}\right\}.$$

The queue-time is equal to the total service time (residual work) of all customers in the system at the instant *t* when we consider the customer that arrives in the system during the server is busy, or it is equal to the sum of the residual duration of vacation and the value of residual work when we consider the customer that arrives in the system during a vacation period. Let us find the function $F(u)$ by using the formula of total probability.

Denote

$$F_1(u,i) = M\left\{e^{juW(t)} \mid \nu(t) = 1, i(t) = i\right\}.$$

$$F_0(u,i,z) = M\left\{e^{juW(t)} \mid \nu(t) = 0, i(t) = i, z(t) = z\right\}.$$

According to the formula of total probability, we can write the equation

$$F(u) = \sum_{i=1}^{\infty} F_1(u,i)P_1(i) + \sum_{i=0}^{\infty}\int_0^{\infty} F_0(u,i,z)P_0(i,dz)\,. \tag{6}$$

For the customer arrived during the server is busy and already *i* customers are accumulated in the system the queue-time is composed of *i* times of the service of the accumulated customers, therefore,

$$F_1(u,i) = \left(\frac{\mu}{\mu - ju}\right)^i. \tag{7}$$

On other hand, when the server is on a vacation, and the system has *i* accumulated customers the queue-time of the arrived customer is made up of the residual time $z(t)$ and the sum of service times of the accumulated customers, so,

$$F_0(u,i.z) = e^{juz}\left(\frac{\mu}{\mu - ju}\right)^i. \tag{8}$$

Substituting expressions (7) and (8) into (6) yields

$$F(u) = \sum_{i=1}^{\infty}\left(\frac{\mu}{\mu - ju}\right)^i P_1(i) + \sum_{i=0}^{\infty}\int_0^{\infty} e^{juz}\left(\frac{\mu}{\mu - ju}\right)^i P_0(i,dz) =$$

$$= G_1\left(\frac{\mu}{\mu - ju}\right) + \int_0^{\infty} e^{juz}\frac{\partial G_0\left(\frac{\mu}{\mu - ju}, z\right)}{\partial z}dz\,. \tag{9}$$

Here generating functions $G_v(y)=\sum_{i=1}^{\infty} y^i P_v(i)$ and $G_0(y,z)=\sum_{i=0}^{\infty} y^i P_0(i,z)$ are defined by the expressions

$$G_0(y)=\frac{\mu-\lambda}{\mu T_1}\cdot\frac{1-T^*(\lambda-\lambda y)}{\lambda(1-y)},$$

$$G_1(y)=\frac{\mu-\lambda}{\mu T_1}\cdot\frac{1-T^*(\lambda-\lambda y)}{(1-y)}\cdot\frac{y}{(\mu-\lambda y)},$$

$$G_0(y,z)=e^{\lambda(1-y)z}\frac{\mu-\lambda}{\mu T_1}\int_0^z e^{-\lambda(1-y)x}\left[T^*(\lambda-\lambda y)-T(x)\right]dx. \qquad (10)$$

Using (10), we can rewrite (9) in the form

$$F(u)=\frac{\mu-\lambda}{\mu T_1}\cdot\left[\frac{1-T^*\left(\lambda-\lambda\frac{\mu}{\mu-ju}\right)}{\left(1-\frac{\mu}{\mu-ju}\right)}\cdot\frac{\frac{\mu}{\mu-ju}}{\left(\mu-\lambda\frac{\mu}{\mu-ju}\right)}+\frac{\Phi(u)-T^*\left(\lambda-\lambda\frac{\mu}{\mu-ju}\right)}{ju-\lambda\left(\frac{\mu}{\mu-ju}-1\right)}\right]$$

where $\Phi(u)=\int_0^{\infty} e^{jux}d\Phi(x)$.

Completing some transformations, we obtain the function $F(u)$ as follows

$$F(u)=\frac{\mu-\lambda}{\mu T_1}\cdot\frac{\mu-ju}{ju(\mu-\lambda-ju)}\left[\Phi(u)-1\right]=\frac{\mu-ju}{\mu T_1}\cdot\frac{\mu-\lambda}{(\mu-\lambda-ju)}\frac{\Phi(u)-1}{juT_1}=$$

$$=\frac{\mu-\lambda}{\mu}\frac{\Phi(u)-1}{juT_1}+\frac{\lambda}{\mu}\frac{\mu-\lambda}{(\mu-\lambda-ju)}\frac{\Phi(u)-1}{juT_1}. \qquad (11)$$

$F(u)$ is the characteristic function of the queue-time $W(t)$. From its resulting form (11), we can conclude that the probability density function $f(x)$ for the queue-time $W(t)$ is a weighted sum of the residual duration of vacations and a distribution of the sum of this value with a positive waiting time in the system M/M/1/∞ [8]. Therefore, the density $f(x)$ has the form

$$f(x)=\frac{\mu-\lambda}{\mu T_1}\left[1-T(x)\right]+\lambda e^{-(\mu-\lambda)x}\int_0^x e^{(\mu-\lambda)z}\left[1-T(z)\right]dz. \qquad (12)$$

Using expression (12) for the probability function density we can find any characteristic of the queue-time $W(t)$.

4. Conclusion

In the paper, we obtain analytical form of the characteristic function for the probability distribution of the number of customers in the queueing system with server vacations in steady-state regime. In the second part, stationary probability density function of the queue-time of a customer is derived in explicit form.

Obtained results will be useful for calculating all stochastic characteristics of various technical systems with server's maintenance or adjustment, and also for investigations in the field of polling systems.

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Does Facebook Usage Bring More Harm Than Good?

Saraswathy Thurairaj[1], Florica Tomos[2]

Universiti Tunku Abdul Rahman, Selangor Malaysia
tsaraswathy@utar.edu.my

University of South Wales
Florica.tomos@southwales.ac.uk

Abstract. In this advance world, much information is circulated through the emergence of the internet. The internet has led us to a popular social networking site known as Facebook which is now used by people of different ages and profession. An easy accessibility via computer, laptop and small portable devices such as tablets and mobile phones has an addendum to its popularity and heavy usage. Malaysians are also not left behind by this technology exposure. In fact, all sorts of people are very much addicted to Facebook during their daily life. A great increase is seen especially amongst the student population. Although there are many advantages of Facebook usage, the disadvantages cannot be overlooked. The data regarding its use and the effect on the life of private university students has not yet been documented. Thus, this study is carried out to determine the effect of Facebook usage towards the student population. Besides, the factors related to the positive and negative effects towards the students are also explored.

Keywords. Social networking site, Facebook, student, addition and usage

1. Introduction

Facebook is not an unfamiliar name in the information and communication technology world anymore. It was first created in 2004 for the Harvard University students for socializing and later this platform was opened for general public in 2006. Now almost everybody is accessing this Facebook every day. According to the recent statistics report, there were 1.18 billion active Facebook users on a daily basis [3]. It is the most popular social network site (SNSs) in recent years with strong mobile integration and mobile messaging aptitudes. The social network has also generated huge sum of annual revenue through advertising that is 12.47 billion U.S dollars in 2014 [3]. In Malaysia, it is estimated that the digital revenue in 2017 will be about 340.57million U.S dollars (RM 1,523.19mil) [4]. According to The Malaysia Digital Association [5], Malaysians spend an average of 5.1 hours a day on the internet, 2.8 hours on social networks and 47% Malaysians access websites from their mobile phone which is very handy. These show that many Malaysians are addicted to the social networks especially Facebook.

Facebook keeps people connected and they can embrace their friendship as well. Some people even find their life partners via Facebook. In addition, Facebook uses can also develop their hobbies, interests, musical tastes, cooking skills, etc. by joining virtual groups. According to Wellman, et al. [6], many individuals using these online SNSs would be connecting with their online friends out site their pre-existing social group. Thus, they have accumulated more friends and get to know them better. However, Facebook also contribute to various disadvantages. The Tech Times [1] has reported that a new study in California suggests that the brain of the facebook users react in a similar way to that of people who use cocaine and

are addicted to gambling. The study also reported that obsession to social media will lead to classical addiction [1].

A lot of research findings have been done discussing the advantages and disadvantages of Facebook. However there are not many studies done on the Facebook usage and the effect on the life of private university students. Hence, this study is conducted to determine the effect of Facebook usage towards the student population. Furthermore, the factors related to the positive and negative effects towards the students are also investigated. This is because Facebook as gain excessive popularity among the private university students too.

This research objective is to investigate the variables that influence students' lives in Universiti Tunku Abdul Rahman (UTAR). The objectives of the study are as follows:

1. To determine the association between hours spent on Facebook and students' lives
2. To examine how Facebook affects students' academic performance and students' lives
3. To investigate how Facebook affects students' socialization and students' lives.

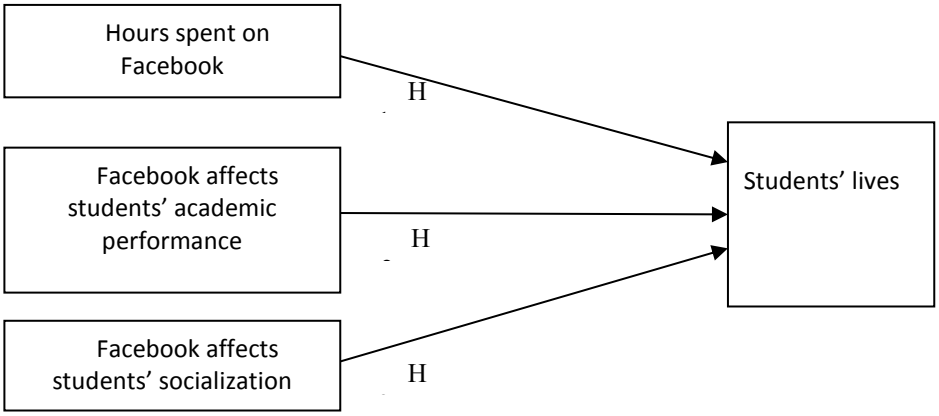


Fig. 1 Research framework

Figure 1 shows the relations among the independent and dependent variables. The independent variables are hours spent on Facebook, Facebook affects students' academic performance and Facebook affects students' socialization; however, the dependent variable is the students' lives. Based on this, our hypotheses are:

- Hypothesis 1: There is a relationship between hours spent on Facebook and students' lives.
- Hypothesis 2: There is a relationship between Facebook affects students' academic performance and students' lives.
- Hypothesis 3: There is a relationship between Facebook affects students' socialization and students' lives.

This area is still remains somewhat under-researched, particularly in the Malaysian context. This study is important to show that social networking sites such as Facebook can affect students' lives while studying in the university. This study also hopes to enrich the knowledge on the study of Facebook on SNSs and to motivate other researchers to conduct further studies in this area.

2. Methodology

This is an exploratory research with hypotheses tested. The authors employed a quantitative research method approach. The study used Survey with questionnaires, which were distributed to 200 students participants in the research. Questionnaires were designed to match the objectives and the hypotheses of this research project. In collecting data for this research, the materials that are used include demographic and background information on Facebook can affect students' lives positively or negativity. It is followed by a series of questions to find out on the Facebook usage intensity, the effect on the students' academic performance and how Facebook can also effect on the students' socialization positively or negatively. For qualitative approach, in depth-interviews with the students were conducted. Target participants were interviewed because they have experienced using Facebook. Hence, these in-depth interviews based on the views and experiences of the students in the task have been more insightful. These in-depth interviews allow more meaningful follow–up questions to be asked and answered and result in more extensive findings. The collected data was analysed using the SPSS mean and mode statistical approach.

The populations for this research were all the year 2 semester 3, Engineering Faculty Students. These students age range is between 20 and 24. A total of 200 students from a private university within the Kajang District of Selangor were selected to undergo this study in order to capture noteworthy results. Actuarial Science Studies students were chosen because they have some exposure to the interaction via Face book especially for their English for Professionals class; therefore the researcher is able to get authentic data from the students. All the participants had passed in their first year English for Engineering and Oral Communication English in year 1 before pursuing to English for Professionals in their year 2. Therefore in terms of writing ability in English, these students were rated as good.

Self-administered questionnaires were considered for gathering data at empirical level. The survey of 30 questions was administered to 200 students (95 females and 105 males) at UTAR. The survey consists of close ended questions in the form of multiple choice questions, Likert scale questions and ranking questions. Respondents responded their level of agreement through the Likert scale questions. The survey also consists of few open ended question which seeks the opinion of respondent in their own words towards the research topic. The respondents were chosen randomly from the Faculty of Engineering and Science (FES) in UTAR Sungai Long campus to avoid respondent from being bias when answering the questions. This also ensures that every individual in the campus has an equal chance of being selected to participate in this research. In order to ensure the quality of the questionnaire, a pilot test was first conducted.

3. Descriptive Statistics

Table 1 provides a summary of demographic information for all respondents, including gender, age, region, owing a Facebook account, courses undertaking.

Table 1 shows that from the total 200 respondents, 105 were male (52.5%) and the remaining 95 were female (47.5%). Male respondents were 5% more than female respondents. Additionally, the table showed that 96.5% of respondents fall under the category of 15-24 years old; however, people within the age of 25-34 years were relatively low (i.e., only 3.5%). Among the respondents, 41% were from the central region (Selangor) followed by 26%, 20.5%, 11% and 1.5% from the southern (Negeri Sembilan, Malacca, Johor), northern (Perlis, Kedah, Penang, Perak), east coast (Kelantan, Terengganu, Pahang) and west coast regions (Sabah, Sarawak) respectively. All the 200 respondents owned a Facebook account. 38% of the participants are from Actuarial Science course, 32% of the participants are from Quantity

Surveying, 12% of the participants are from Architecture, 9% of the students are from Construction Management, 6% of the students are from Mechanical Engineering and 3% of the participants are from Financial Mathematics Studies.

Table 1: Respondents' Profile

Characteristic	Frequency	Percent (%)	Cumulative percent (%)
Gender			
Male	105	52.5	52.5
Female	95	47.5	100.0
Age			
15-24 years	193	96.5	96.5
25-34 years	7	3.5	100.0
Region			
Northern Region	41	20.5	11
Central Region	82	41	61.5
Southern Region	52	26	87.5
East Coast Region	22	11	98.5
West Coast Region	3	1.5	100.0
Facebook Account			
Yes	200	100.0	100.0
No	0	0	0
Courses			
Actuarial Science	76	38	38
Quantity Surveying	64	32	70
Architecture	24	12	82
Construction Management	18	9	91
Financial Mathematics	6	3	94
Mechanical Engineering	12	6	100.0

4. Findings

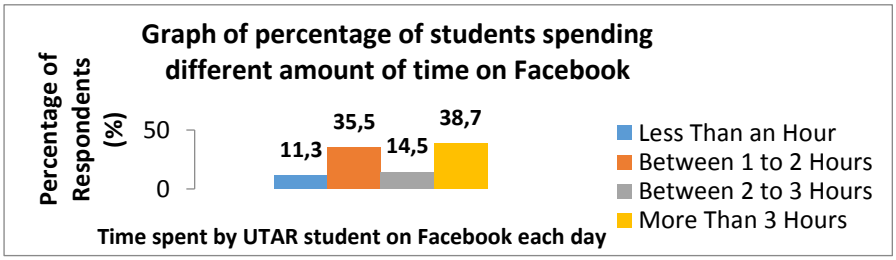
4.1. Amount of time spent by students on Facebook each day

According to Facebook.com statistics, ever since Facebook opened its doors to people outside of Harvard University's network, there have been over 350 million subscribers worldwide and 8 million users are from Malaysia. Hanina H. & Matthew N. and Mohamad I. state that, "Facebook has become very popular among undergraduates, with usage rates upwards of 90% at most campuses." (2013: 22) Therefore, our study has carried out to investigate on how often these individuals use Facebook in their daily routines.

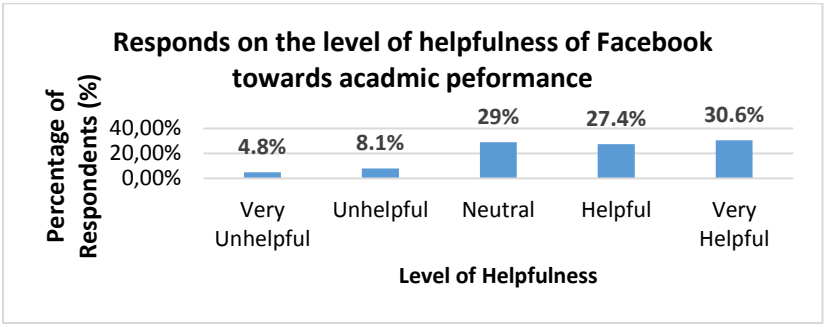
The bar chart above shows a normal distribution of the percentage of time consumed by UTAR students on Facebook. 11.3 percent of UTAR students have claimed that they spend less than an hour to surf Facebook in their daily life. However, the trend reveals that there is a

sharp increase in the percentage when 35.5 percent of students spent almost 1 to 2 hours on Facebook. However, 9 respondents have admitted that they have spent almost 2 to 3 hours in Facebook usage a day. The tendency demonstrates that the percentage rocketed intensely to the peak with 38.7 percent of total respondents showing that they have spent more than 3 hours on Facebook.

In conclusion, the majority of the students agree that they have spent more than 3 hours in Facebook a day. Interestingly, more than half of the respondents personally feel that the amount of time consumed for their Facebook is appropriate. This is a positive sign, with which the assumptions could be made that many respondents still think that they need to have affiliations to offline activities. However, when it comes to the question about the uneasiness if they do not login into their Facebook account in a day, most of them state that it is uneasy. This further suggests that they are accustomed to using Facebook as a part of daily routines.



4.2. Level of helpfulness of Facebook towards students' academic performance



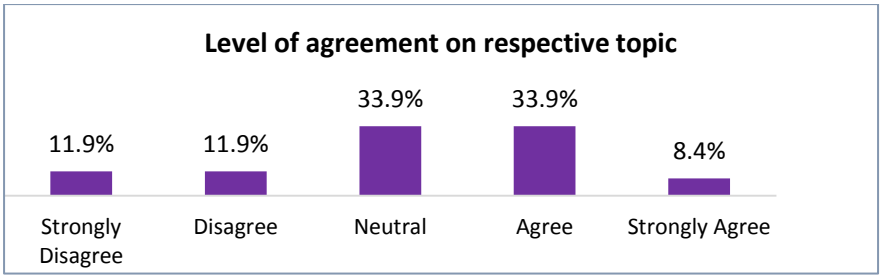
Majority of Facebook users are teenagers which also happen to be students. The usage of Facebook on their daily lives plays a huge impact on their academic performance whether for good or for bad. Addiction of using Facebook without discipline might bring negative effects towards a student's academic performance but with proper guidance and discipline Facebook can actually help a student improve their academic performance by providing useful information.

Based on our survey we found that most students agree that Facebook is actually bringing more good than harm towards their academic performance. Even though 29% of the respondents stand neutral on this topic, there is a significant amount of 58% of students that agrees that Facebook is actually helping them in terms of their academic performance. However on the other side there is still a small amount of 13% of the students who thinks that Facebook is bringing a bad influence and its dragging down their academic performance.

In conclusion, it is safe to say that most students agree that Facebook is helping them in terms of their academic performance. Even though there are side effects when using

Facebook like it might causes us to procrastinate our work, with proper discipline Facebook can actually bring more good towards a student's academic performance. It is found that there is a huge amount of student access Facebook to get information for their academic performance by using Facebook's system such as the news feed or search bar. Students also tend to deliver information towards one another by using Facebook's inbox system and the group discussion section.

4.3. The lack of attention or being strongly criticized on Facebook can causes someone to be emotional unstable and leads to emotional breakdown.



Socialization, is a term used to refer to the lifelong process of inheriting and disseminating norms, customs, values and ideologies, providing an individual with the skills and habits necessary for participating within their own society. These days, teenagers especially students use Facebook as a social media to socialize with others. Socialization has become a part and parcel of their daily live. However if social media are handled without proper care, student's might find themselves facing social problems in their daily lives.

The figures above represents the student's opinion on whether does the lack of attention or being strongly criticized on Facebook can causes someone to be emotional unstable and leads to emotional breakdown. Based on the graph, 43.5% of the respondents agree to this statement where there are 9.6% of them that strongly stand with this point. However there is also a decent amount of 22.6% of respondents where they disagree on the statement give and thinks that the attention given in Facebook does not affect a person's emotional condition. A fair amount of 33.9% of the respondents actually stands neutral and has no comment towards the statement.

Based on the results, we find out that there is different opinion on the statement. However we can still determine that Facebook is playing a significant role in student's daily lives. Majority of students uses Facebook to keep in touch with long distance friends and they often provide an update of their current situation through Facebook. Some of the students also uses Facebook for online shopping and gaming. However spending too much time on Facebook might also lead student into social problem. A few respondents encountered social problems such as being harassed on Facebook. In the nutshell, we can conclude that Facebook is actually a safe place for students to socialize if used appropriately and handled with care.

5. Conclusion

Based on everything in the research, we realize that Facebook is actually safe to use and it can bring a lot of benefits to students if it is used correctly. Most of the students are actually really satisfied with their visit on Facebook and the information and entertainment that it provides.

One of the student stated in the open ended question that "Even though Facebook can causes students problems such as causing them to procrastinate in terms of their academic work, but with proper care and usage it actually provides a lot of information and helps students in terms of their academic performance."

With the statement above we can conclude that as long as we can control our self by having self-discipline during our visit on Facebook, there should be no problems encountered and with appropriate usage we can obtain the benefits that Facebook has to provide.

6. Recommendation

It is highly recommended that students should have self-discipline during their visit on Facebook. Action done on Facebook should also be handled with care and have a fair amount of thought should be done before doing anything on Facebook.

i. Amount of time spent on Facebook.

Students should know the proper amount of time they spend on Facebook each day and not exceed the boundaries. Self-discipline is important on time spend on Facebook.

ii. Acquiring accurate information

Students should learn the difference between true or false information provided on Facebook as it is filled with inaccurate information. With good judgments student can obtain plenty of helpful information on Facebook.

iii. Appropriate action when facing social problems on Facebook.

Students should act accordingly when facing social problems on Facebook. They should also seek help or guidance from experienced individual or from adults when encountering scams or getting harassed on Facebook.

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Biometric Cryptosystem Security Threats

Madjit Karimov, Zarif Khudoykulov, Shahboz Islomov

A. Temur street 108, 100202 Tashkent, Uzbekistan
m.karimov@tdtu.uz, zarif.xudoyqulov@mail.ru, shaxboz4044@gmail.com

Abstract. Biometrics is not use only in biometric systems to provide a better and stronger factor of authentication, but also, it may use to generate or binding cryptographic key. Biometric based cryptography solves traditional security problems, such as, losing, dictionary based attacks. On the other hand, biometric cryptosystems has its own security vulnerabilities. In this paper, we discuss vulnerability points in biometric cryptosystems and possible attacks through them.

Keywords. Biometric cryptography, key – binding, key generation, fuzzy commitment, fuzzy extractor.

1. Introduction

The term biometrics is defined as "*a measurable physical characteristic or personal behavioral trait used to recognize the identity, or verify the claimed identity, of an applicant*"(NISTIR 7298). Physiological as well as behavioral biometric characteristics are acquired applying adequate sensors and distinctive features are extracted to form a biometric template in an enrollment process. At the time of verification or identification, (identification can be handled as a sequence of verifications and screenings) the system processes another biometric input, which is compared against the stored template, yielding acceptance or rejection.

While cryptographic applications vary widely in terms of assumptions, constructions, and goals, all require cryptographic keys. In practical applications, passwords are used as cryptographic keys or cryptographic keys are stored in security tokens. Both methods have its enough security problems. Storing good passwords in people memory is hard work and lost token may be cause to serious security problems.

As a result, researchers have devoted significant effort to finding input that has sufficient unpredictability to be used in cryptographic applications, but that remains easy for humans to regenerate reliably. One of the more promising suggestions in this direction are biometrics - characteristics of human physiology or behavior. Biometrics are attractive as a means for key generation as they are easily reproducible by the legitimate user, yet potentially difficult for an adversary to guess.

The primary difficulty with biometric encryption systems is the variability in the biometric image between data measurements. In the case of biometric encryption, it means that an image cannot be treated as a code by itself, since it varies with each presentation. For biometric encryption systems, this variability becomes especially difficult. An algorithm must be designed which allows one image, with certain significant differences from the original, to decode the complete secret code, while another image, only slightly more different form the original, must not allow decoding of any information.

This paper considers possible approaches to attacking biometric encryption based algorithms. If an algorithm does not completely prevent information leak from non-matching images, it may be possible to gather such information over many iterations.

2. Biometric Template Protection Methods

Biometric template protection schemes, which are commonly categorized as biometric cryptosystems (also referred to as helper data methods), and cancelable biometrics (referred to as feature transformation) (Fig. 1).

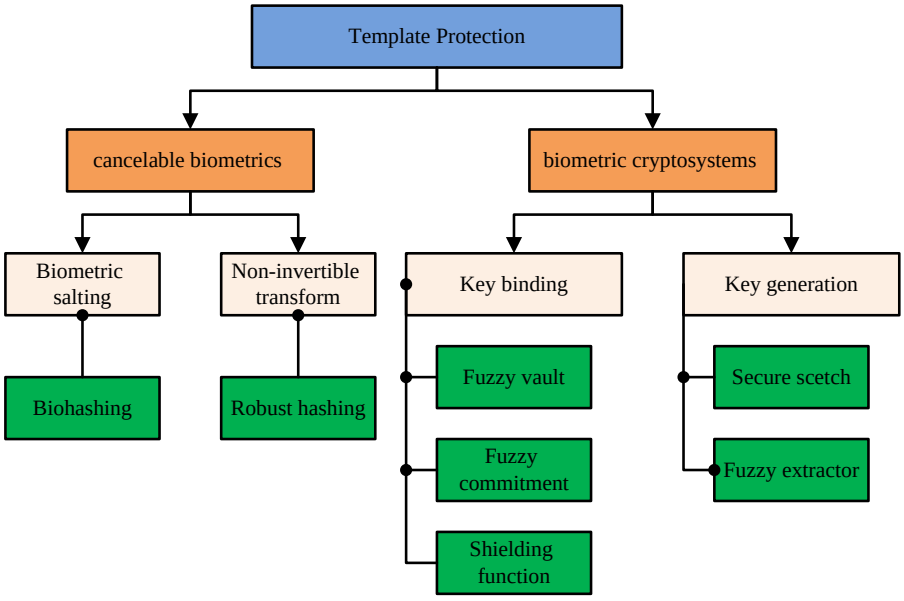

Fig. 1. Category of template protection methods

Biometric cryptosystems are designed to securely bind a cryptographic key to a biometric or securely generate a cryptographic key from a biometrics. These systems offer solutions to biometric-dependent key-release and biometric template protection. Biometric cryptosystems aim to generate helper data using a secret key and user biometric features. This helper data is the only stored data (meaning that the secret key and the biometric feature are not stored). During authentication, the secret key is retrieved using request biometric features and the helper data for a successful authentication.

Cancelable biometrics consist of intentional, repeatable distortions of biometric signals based on transforms, which provide a comparison of biometric templates in the transformed domain [1]. A transformation function is designed using the key generated from the random key or password. The biometric template is transformed by applying the transformation function. The transformed template is stored in the database. Similarly, the Query template is also transformed using the same transformation function.

These template protection schemes must have following desirable characteristics:

a) *Diversity:* To ensure privacy, secure template must not allow cross matching or function creep.

b) *Revocability:* Compromised template should be revoked and it must be possible to reissue a new template from the same biometric data.

c) *Security:* It should not be possible to generate the original template from the secured template.

d) *Performance:* The operation of the protection scheme should not degrade the recognition performance (False acceptance rate and false rejection rate) of the biometric system.

3. Vulnerable Points in Biometric System

To fully understand how biometric systems can be attacked, firstly must understand the biometric system model and the different modules it consists of. Fig. 2 shows a generic biometric system and the eight vulnerable points [2].

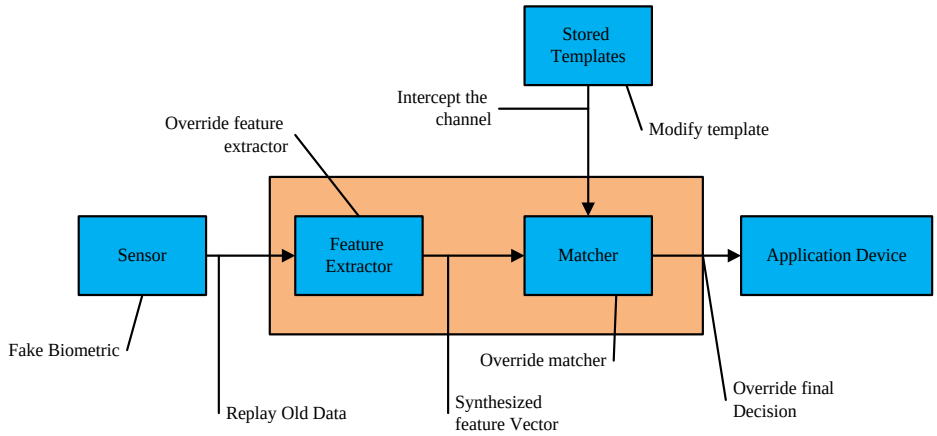

Fig. 2. Eight vulnerable points in the biometric systems

The scanner module in a biometric system is used to scan and acquire the biometric data (e.g., fingerprint, hand vein, palm print etc.) of an individual. The scanner module might be differently device depend on biometrics type. This module is vulnerable to face biometrics attack.

The feature extractor module in a biometric system operates on the signal sent by the scanner module to extract a feature set that represents the given signal. This module consist of digital image processing methods to convert image to digital numbers. This module has override feature extractor vulnerabilities.

The stored templates module in a biometric system is usually a database that stores biometric feature sets called templates in enrollment phrase. This saved template is used next time in recognition phrase to match new biometric. This template may be unauthorized modified by attacker.

The matcher module in a biometric system is the main module in such system. The matcher receive two biometric features from stored template and feature extractor module. These received features match based on given algorithms. The matcher is vulnerable override matcher attack.

The application device module in a biometric system receives an answer from the matcher and acts accordingly. This module give access to users based on matching results.

Table 1 shows the example attacks for the eight vulnerable points.

Possible attacks at different point	Example attacks
A fake biometric trait	An artificial finger, may be presented at the sensor
Replay old data	Illegally intercepted data may be resubmitted to the system.
Override Feature Extractor	A Trojan horse program that produces predetermined feature sets may replace feature extractor.
Synthesized feature sets	Legitimate feature sets may be replaced with synthetic feature sets
Override feature Extractor	The matcher may be replaced by a Trojan horse program
Modify Template	Templates stored may be modified or removed; new templates may be introduced
Intercept the Channel	The data in the communication channel may be altered
Override Final decision	The final decision output by the biometric system may be overridden.

4. Attacks Against Biometric Key Generators

Biometric based key generators are built directly/indirectly on biometric systems. Thus, biometric systems vulnerabilities are occurred in biometric cryptography. The technologies of biometric cryptosystems and cancelable biometrics prevent from different traditional attacks while they appear still vulnerable to some. The most common points of attacks to a biometric system are shown in Fig. 2.

In [3], author classifies two broad classes of popular attacks. The first class is based on extracting information from poorly designed biometric key generators. The second class of attacks attempts to replicate the biometric input. One of the most prominent types of attacks in the first class are so-called "hill-climbing" attacks. Another common technique for subverting biometric key generators is to simply predict the target user's biometric.

In [1], authors separate each attacks into biometric cryptosystems. In Table 2 an overview of specific attacks proposed against biometric cryptosystem technologies is given.

Table 2. Potential attacks against biometric cryptosystems.

Technology	Proposed attack(s)
Biometric encryption	Blended substitution attack, attack via record multiplicity, masquerade attack (hill climbing)
Fuzzy commitment scheme	Attacks on error correcting codes
Shielding functions	Attack via record multiplicity
Fuzzy vault scheme	Blended substitution attack, attack via record multiplicity, chaff elimination
Key-Gen. Schemes	False acceptance attack, masquerade attack, brute force attack
Biometric hardend passwords	Power consumption observation

Brute Force Attack. In this attack, attacker tries every possible bit combination until they guess the correct original feature data or key. This attack is time-consuming and need a way to test each bit combinations (Fig. 3) [4].

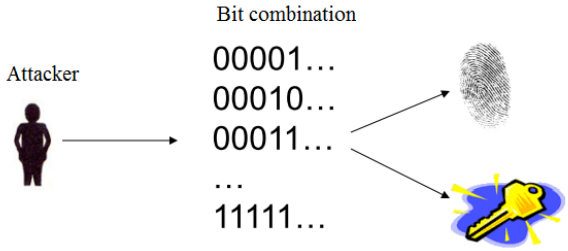

Fig. 3. Brute Force Attack

This attack is more suitable for biometric based key generation methods since biometric has not enough information to generate long key.

Hill-climbing attack. Hill-climbing attacks consist of an application that sends synthetically generated minutiae templates to the matcher and, according to the match score, randomly modifies the templates until the decision threshold is exceeded [4]. This attack requires less than brute-force effort to recover an embedded secret and provides an estimate of the enrollment image. A hill-climbing attack may be performed by an application that sends random templates to the system, which are perturbed iteratively. The application reads the output match score and continues with the perturbed template only when the matching score increases until the decision threshold is exceeded. In an iterative fashion, modifications are made to the input, and those that increase the match score are retained (Fig. 4).

Fig. 4. Modified Face Image

False acceptance attack. If the false acceptance rate is one in given biometrics, an attacker can try more biometrics. Since biometric based key-generation schemes tend to reveal worse accuracy compared to biometric based key-binding approaches (unless a large number of enrollment samples are applied), these are expected to be highly vulnerable to false acceptance attacks. This attack looks like biometric dictionary attack. In this attack, attacker may use many open biometric database (such as, Fingerprint: NIST DB 14, NIST DB 29, FVC 2002, or Face: ORL, MBGC, FRGC, FVT, and FERET).

Attacks on error correcting codes. Error Correcting Codes are widely used today in combination with cryptographic hash functions in the design of biometric systems with secure template storage. The selected error correcting codes strongly affects the performance of the

system in terms of false rejection rate and false acceptance rate and, therefore, the choice of the code must be done very carefully.

Despite biometric cryptosystems is provable secure in information theoretic sense, it is indeed vulnerable to several dreadful security and privacy attacks in practice. Here only described a few attacks that have been attributed to error correcting codes [5].

Substitution attack. Performing substitution attacks to biometric cryptosystems is more difficult compared to conventional biometric systems since biometric templates are either bound to cryptographic keys or used to extract helper data (the original biometric template is discarded). Substitution attacks against biometric cryptosystems require additional knowledge (e.g., of bound keys in case of key-binding schemes) [6]. Based on this attack, attacker must change user's template and secret key to his or her. The attacker's data may be directly injected before encoding, or pre-encoded and inserted into the message before (or after) it has been accepted into the database. The database holds only the attacker's data.

Attacks via Record Multiplicity. Based on this attack, attacker collects many templates correlated user's template or enrollment template. Combining all these data may be helpful to retrieve the user's secret template and secret key. Therefore, this attack also referred as Correlation Attack.

Known Key Attack. Keys used in authentication or cryptographic systems may be stolen or recover by attacker. To achieve this gain, attacker may use Trojan horse programs or social engineering. Even for external attackers, traditional system attacks have exploited unprotected data transmission, unencrypted memory and virtual memory.

5. Conclusion

In this paper, we give attacks analysis on biometric based cryptography. Biometric based key generation methods solve problems that may occurred in password based or token based key generation methods. However, biometric cryptography has its own security problems. Taken analysis results can be helpful to researcher in biometric cryptosystem. Every new created biometric cryptosystem method must be stronger against these attacks.

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Building User Interface and Domain Models Based on the Users' Cognitive Characteristics and Work Process Specifics

Yurii Furtat

Pukhov Institute for Modelling in Energy Engineering,
National Academy of Sciences of Ukraine, Kyiv, Ukraine
saodhar@ukr.net

Abstract. The principles of construction and management of the automated systems' UI (responsible for a form of presenting information to the user) and domain (responsible for a form of presenting information to the user) models are considered as components means complex for managing user's informational interaction with the automated system management means, adapting this interaction to the user's individual characteristics and work process specifics.

Keywords. Informational interaction, adaptation, domain model, user's cognitive characteristics

1. Introduction

User interaction with information in the automated system is conducted through system generating an information flow [1-3] that the user perceives and processes (fig. 1).

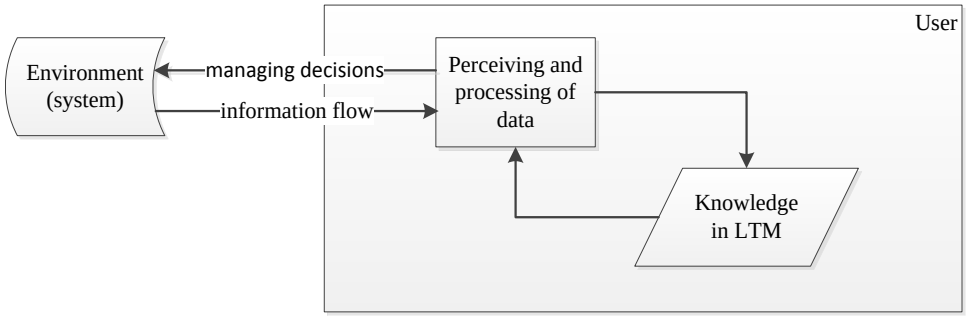

Fig. 1 – User-system informational interaction scheme

Based on received information users make some decisions using their own skills and knowledge in long-term memory (LTM), that are transmitted via the user interface to the system, changing its state. Set of UI management elements is determined by the specific workflow tasks and user's characteristics.

The flow of information from the system is formed with regard to the user's requests to the system, current workflow step and user interface's output elements through which data will be displayed for the perception and processing of the user. Each of the participants and the elements of information exchange has a number of features, by managing which the process can be adapted to the specific user and the specific situation in the workflow.

2. Information flow parameters and adaptation

Information flow *I* from the system can be described as a set of parameters:

$$I = \langle T, F, C, D \rangle, \quad (1)$$

T – pace of presentation, *F* – data format, *C* – information complexity, its connectivity to other blocks of data, *D* – transmitted.

Pace of presentation is a qualitative characteristic that can be set to *T* = <"low", "medium", "high">. The pace of presenting information in automated systems can be managed in non-critical situations by changing the flow intensity depending on the acceptable level of information load. The users' optimal rate is determined by their ability to respond quickly to data from the system, and the current level of fatigue and concentration.

Data format *F* can be "text", "graphic", "spreadsheet", "audio", "mixed". In general, data format is defined by the user interface's output elements, yet if there is a possibility of changing this set according to users' needs and demands presentation format can also be adapted to the users' characteristics (their cognitive portraits).

The complexity of information - a complex value, which takes into account the links between data blocks in the domain model, the data links amount involved in presenting current portion of data, its overlapping with the user's knowledge model

$$KM = \left\langle K_i, \left\langle c^j \right\rangle_i \right\rangle, i, j = \overline{1,n} \quad (2)$$

$K_i, i = \overline{1,n}$ – domain data blocks, $\left\langle c^j \right\rangle_i, i = \overline{1,n},\ j = \overline{1,n},\ j \neq i$ – i^{th} data block's connection vector.

Parameter *D* is a portion of data transferred to the user in the particular workflow episode. This portion may correspond to one domain data block or it may consist of a set of blocks or a part of a single block, depending on the user-system interaction script.

In most modern automated systems user-system interaction is defined by the following algorithm (fig. 2).

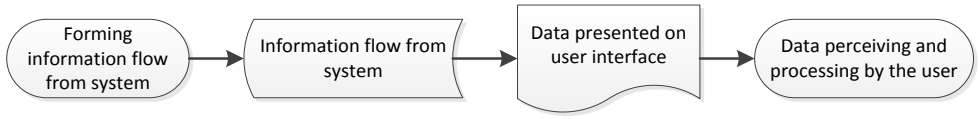

Fig. 2 – User-system information interaction

To perform information exchange adaptation the algorithm in fig. 1 should be modified to allow consideration of specific users' and workflows' characteristics.

As adaptation criterion the users' cognitive portraits are considered, as adaptation object – data presentation form and pace (information flow characteristics).

If the user-system informational interaction process's adaptation and personalization is considered as controlling parameters of an information flow (1), we obtain a modified information exchange, shown in fig. 3.

Information exchange adaptation and personalizing is performed at the stage of information flow's forming (managing parameters *T* and *C* of model (1)) and at the stage of data output through user interface (managing parameter *F*). Information flow's parameter *D* depends on the specifics of the overall workflow, and on the current users' specific goals.

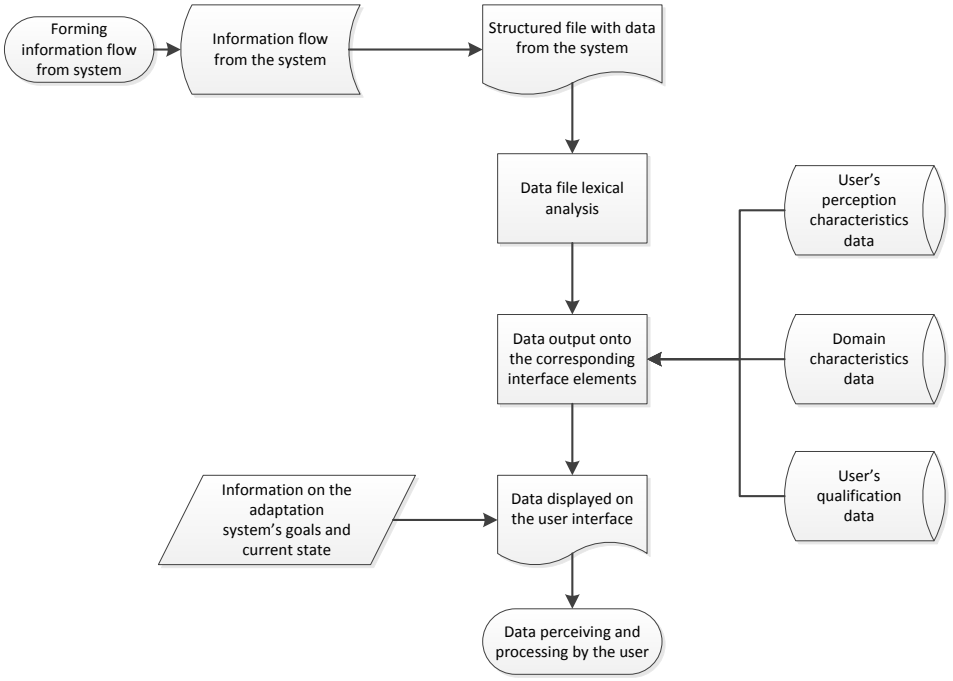

Fig. 3 – Adapted user-system information interaction

3. Managing data output through personalized user interface

User interface in automated systems is considered as a set of elements $UI = \langle E_i \rangle,\ i = \overline{1,n},$ each output element

$$E_i = \left\langle \langle x, y \rangle_i^j, T_i, c_i \right\rangle,\ j = \overline{1,m} \qquad (3)$$

$\langle x, y \rangle_i^j$ – output element's corner coordinates; T_i – i^{th} element's output type; c_i – i^{th} element's weight (importance) for the user.

The set of values of T_i in model (3) coincides with the set of values of parameter *F in* model (1), and it is the type of available output elements which determines the preferred output data format on the information flow's formation stage.

Output element's weight is defined by the workflow's specifics. Critical elements display information, loos of which to disruption of the workflow or inability for the user to correctly process information from the system.

Managing output elements' position and type allows creating personalized user interface for adapting the user-system information interaction. Critical output elements output must be present in the user interface, regardless of its adaptation.

Desired output element types are defined by the users' cognitive portraits' characteristics. Cognitive portrait is a set of user characteristics.

$$CP = \left\langle \langle Cogn_i \rangle, \langle PP_j \rangle, \langle Int_k \rangle \right\rangle,\ i = \overline{1,m},\ j = \overline{1,n},\ k = \overline{1,p}, \qquad (4)$$

$Cogn_i$ – cognitive users' characteristics; PP_j – physiological characteristics; Int_k – intellectual characteristics.

Cognitive portrait's characteristics define optimal for on-screen data presentation number, type and relative position of user interface output elements.

4. Using domain knowledge model to manage information storage form

To enable further flexible information interaction adaptation it is advisable to manage not only presentation form, but the pace and intensity of information flow. This requires the ability to manage blocks of information, knowledge system organization.

Existing knowledge communications systems can be characterized by four basic components: expert domain knowledge (domain model); user model; expert knowledge of teaching method (interaction script); user-system interface.

Knowledge model (2) performs a dual function. On the one hand it is a source of domain knowledge that is provided to the user in portions, on the other – it sets the desired standard for the users' current knowledge level evaluation. Domain model has an important place in the process of scripting user interaction with the information and in the management of information flow characteristics within decision-making metascript in automated systems.

User model is generally an incomplete modified model domain knowledge model (2) and is designed mainly to anticipate users' behavior for its interpretation. The ideal user model must make accurate predictions of the behavior of any user in any domain context. For example, a set of possible responses to a block of data from the system.

With the user model's concept a diagnostic process is often associated –adapting the user model based on the data obtained through user-system dialog.

Interaction script determines which piece of data and at what time will be transmitted to the user. In the most general case the interaction script is not hard coded and is derived based on the current situation and the deduction method, stored as a set of principles or rules. The adaptation is based on predicting users' responses, generated by user models, users' real reaction and relations between the workflow episodes stored in the domain model.

Interaction scripts may vary in relation to the degree of "freedom" given to the user, and can range between two extremities: full control of all user actions and guiding users through workflow episodes workflow – or complete freedom of user's navigational activity and giving requests-based recommendations. Fig. 4 illustrates relationship between these four basic concepts of knowledge communication.

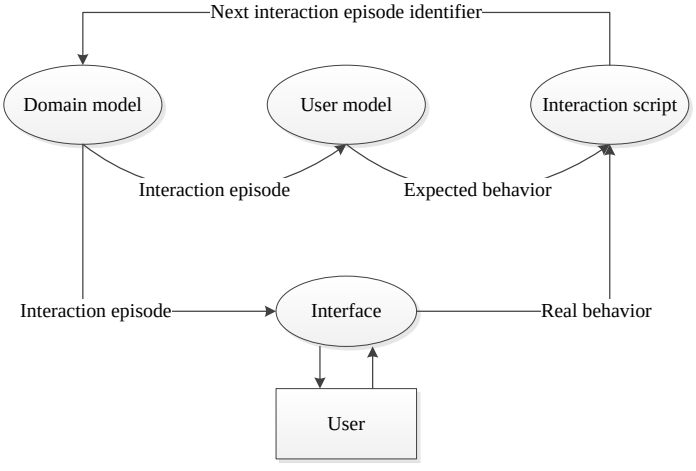

Fig. 4. Basic concepts of knowledge communication systems

User system interaction's script construction and modification takes into account the interaction script, based on the users' model and their actual behavior when processing previous information blocks taken from the domain model.

5. Conclusion

By using models of user interface, users' cognitive portraits, domain and users' knowledge is it possible to perform flexible adaptation and personalization of user-systems interface. Such adaptation involves modifying not only data presentation, but also data storage and he script of the interaction itself based on the workflow specifics and the users' preferences. This results in fewer mistakes when perceiving and processing information and lower stress levels for the users.

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On a Model Support for Building Recommendation System for Enrollment on Optional Disciplines

Oleksii Oletsky

National Kyiv-Mohyla AcademyUniversity, Kyiv, Ukraine
oletsky@ukr.net

Abstract. The paper describes some approaches of building recommendation system which would assist students in choosing the most suitable optional courses to enroll themselves. These approaches are based on combining enrollment and e-learning services with underlying model support for decision making. Models based on fuzzy optimization tasks, fuzzy similarity measures, Data Mining and Web Usage Mining have been considered.

Keywords. E-learning, Recommendation system, Fuzzy optimization task, Fuzzy similarity measures, Data Mining

1. Introduction

Information technologies are rapidly developing now. For classical universities, it becomes more and more difficult to cope with this progress. Lot of knowledge obtained by students at the first years of their study becomes out-of-date when they have graduated. So the educational workflow in the field of IT and not only in IT should be drastically changed. There is an obvious need to make the whole educational process as well as all study curricula and syllabi more flexible. The wide-spread development of blended and collaborative learning is a good innovative way to this.

Provided that students have free access to study materials stored in the digital repository, they are able to form their study trajectories to a great extent by their own. Students are getting enabled to choose optional disciplines at the level of the whole curriculum and to find out the most suitable and individual ways of studying specific subjects.

It appears that systems for automated enrollment of students on optional disciplines should be complemented with features of recommendation systems addressing both to students and to faculties. For students, such systems should provide recommendations about choosing the most useful disciplines. For faculties, such systems should elaborate recommendations about making the best proposals of selecting disciplines for enrollment.

For working out such recommendations, a framework based on some kind of model support should be developed. This implies some basic models for decision making and techniques for operating with them.

2. The main components of the framework

We consider the following components of the framework:

- implementing classical approach of expert systems;
- building optimization tasks including fuzzy optimization;
- use of agent-based modeling on the base of Markov chains and reinforcement learning;
- use of similarity measures;
- use of Data Mining and Web Usage Mining.

An environment for operating these models is being developed as well.

3. The classical expert approach

One of the possibilities regarded here is based on the approach typical for expert systems [1, 2]. It implies constructing a set of production rules "if A then B". An example written in the Prolog-like notation may be the following:

```
recommend(X,S,yes):-knowledge(S,programming,solid),
advanced(X,yes).

recommend(X,S,yes):-knowledge(S,programming,weak),
advanced(X,no).

advanced(pascal,no).

advanced(java,yes).
```

This classical approach may be enhanced by using machine learning. We can assign some weight to each rule, and then an inference will be carried out with some extent of certainty. Then we can increase or decrease these coefficients depending on the recommendations provided by the system were good or not.

4. Use of optimization models

Provided enough appropriate information is available we can apply an approach based on solving different kinds of optimization tasks.

In a simplest case, we consider the following parameters. Let $D=\{d_1,\dots d_n\}$ be a set of optional disciplines, $c_i,\ i=1,\dots n$ be the usefulness of the i-th discipline and $q_i,\ i=1,\dots,n$ be a number of credits for the i-th discipline. We suppose that students make their choices independently, and moreover we can admit that an unique optimization problem is invariant to a specific student. So we introduce the boolean variable

$$x_i = \begin{cases} 1, \ if\ the\ student\ chooses\ i-th\ discipline \\ 0, otherwise \end{cases}$$

Then the following optimization task arises:

$$\sum_{i=1}^{n} c_i x_i \to \max,$$

$$\sum_{i=1}^{n} q_i x_i \le W,$$

$$x_i \in \{0,1\}$$

where W is a given limit for the total amount of credits.

But the actual reality is not so simple, and we have to consider different variations of this basic model depending on the actual conditions.

First of all, the coefficients c_i are the formal measures for the weights of disciplines. Beside them it may be useful to consider informal measures w_i reflecting the hardness of each discipline. Then we have to consider the modified optimization model

$$\sum_{i=1}^{n} c_i x_i \to \max,$$

$$\sum_{i=1}^{n} w_i x_i \to \min,$$

$$\sum_{i=1}^{n} q_i x_i \le W,$$

$$x_i \in \{0,1\}$$

This problem is multi-criteria, and for solving it we should apply different methods of multi-criteria optimization.

Another multi-criteria problem arises if we take into account relations between university disciplines and the ontology of the subject domain. Each discipline provides its own contribution to studying certain concepts; let v_{ik} be the contributions of the i-th discipline to the k-th concept, and the total amount of concepts is M. Then we can regard a problem

$$\sum_{i} v_{ik} x_i \to \max,\ k = 1,\ldots, M$$

$$\sum_{i} q_i x_i \to \min,$$

$$\sum_{i} w_i x_i \le W,$$

$$x_i \in \{0,1\}$$

A known approach to deal with such kind of problems is to introduce coefficients α_k meaning the importance of the k-th concept. Thus we can reduce the problem to the following single-criterion task

$$\sum_{k=1}^{M} \alpha_k (\beta \sum_{i=1}^{n} c_{ik} x_i - \gamma \sum_{i=1}^{n} w_i x_i) - > \max,$$

$$\sum_{i=1}^{n} q_i x_i \le W,$$

$$\sum_{k=1}^{M} \alpha_k = 1,$$

$$\beta + \gamma = 1,$$

$$x_i \in \{0,1\}.$$

$$\alpha_i, \beta, \gamma \in [0,1]$$

where β and γ are certain coefficients defining an effective balance between usefulness of the discipline and its hardness.

Another problem is that the goal function, coefficients and limitations may be not accurately defined. Then they should be considered as fuzzy variables, and a fuzzy optimization problem arises. Methods of solving such problems are rapidly developing now [3].

5. Agent-based modeling on the base of Markov chains and reinforcement learning

Agent-based modeling and simulation is commonly used if the available information is not sufficient to get a solution at once but this information can be accumulated in the course of getting experience. Techniques of reinforcement learning [4] appear to be very reasonable and effective under such conditions.

In a recommendation system for enrolling students, we regard at least two levels of making decisions: the level of students and the control level. We distinguish two very different situations: whether actions are chosen occasionally or whether an agent accumulates experience, analyses the situation, learns and makes intelligent decisions.

If decisions are made randomly then models of Markov chains can be applied. We regard a set of possible states $S=\{s_1,\dots,s_n\}$; these states may be compound. Then the main issue is to get the matrix of transitional probabilities $\Pi=(\pi_{ij}),i,j=1,\dots,n$ where π_{ij} is the probability that an agent in a certain moment moves from the i-th state to the j-th. By this matrix we can get the vector p of stationary probabilities as the solution of the equation

$$p=p\Pi,$$

and the components of the vector p are regarded as the importance measures of the states.

We regard different ways of getting sets of states, different models of possible agents' behavior etc. Consequently, we build different methods for getting transitional probabilities. Some of them are similar to the well-known PageRank algorithm [5], others are very different.

If an agent learns and makes decisions intelligently, models on the base of Markov decision making processes [4] are used.

In our investigation, we are trying to combine both approaches and to use different techniques depending on actual conditions. For this purpose, different connected random processes are regarded:

- a process of transition between states;
- a process of making decisions;
- a process of getting rewards;
- a process of renewing knowledge.

6. Use of similarity measures

The quality of recommendations can be significantly improved by taking into account the ontology of the subject domain. We consider a model on the base of a compound semantic network which covers nodes of the ontology, disciplines and learning materials and relations between them [6]. Using this model, we can measure similarities between different nodes of the network, and on this base we can choose the most appropriate nodes.

We develop an approach different from the most commonly used one. Usually the most similar nodes are considered to be the most relevant. This is not undoubtedly for e-learning and some other fields. Indeed, if a node is very similar to already visited ones then the student probably knows this stuff and therefore it's no reason to recommend it. On the other hand, very distant nodes are probably not relevant as well.

So we propose a fuzzy recommendation rule "`if the DISTANCE is AVERAGE then the RELEVANCE is HIGH`", where `AVERAGE DISTANCE and HIGH RELEVANCE` are fuzzy concepts defined by their membership functions. Let's consider a simple example [7].

Let the set of documents $D=\{D_1,...D_{10}\}$ and the set of terms $T=\{T_1,...,T_8\}$ are given and let the current document is D_1. We need to calculate measures of relevance for all other documents. We consider that distances and relevancy measures are normalized and their maximal value equals 1.

First of all, we need to calculate distances from D_1 to other documents. We let out this routine step and consider distances to be already calculated and ordered by ascendance:

$\rho(D_1,D_2) = 0;$
$\rho(D_1,D_3) = 0.05;$
$\rho(D_1,D_4) = 0.1;$
$\rho(D_1,D_5) = 0.2;$
$\rho(D_1,D_6) = 0.25;$
$\rho(D_1,D_7) = 0.4;$
$\rho(D_1,D_8) = 0.6;$
$\rho(D_1,D_9) = 0.8;$
$\rho(D_1,D_{10}) = 1;$

A recommendation system using the common approach should arrange the documents in the order given above: from D_2 to D_{10}.

Let's define the membership function for the fuzzy concept `HIGH RELEVANCE` as the following:

$\mu_B(0)=0;\ldots;\ \mu_B(0.5)=0;\ \mu_B(0.55)=0.05;\ \mu_B(0.65)=0.2;\ \mu_B(0.75)=0.4;\ \mu_B(0.8)=0.5;\ \mu_B(0.85)=0.7;\ \mu_B(0.9)=0.8;\ ;\ \mu_B(0.95)=0.9;\ \mu_B(1)=1.;$

Let the membership function for the fuzzy concept `AVERAGE DISTANCE` be the following:

$\mu_A(0.)=0;\ \mu_A(0.05)=0.3;\ \mu_A(0.1)=0.5;\ \mu_A(0.15)=0.75;\ \mu_A(0.2)=1.;\ \mu_A(0.25)=0.9;\ \mu_A(0.3)=0.7;\ \mu_A(0.5)=0.6;\ \mu_A(0.6)=0.3;\ \mu_A(0.9.)=0.1;\ \mu_A(1.)=0;$

Then by using simple substitution we get the following measures of relevance (if there is no exact value we took the nearest to it):

$v(D_2)=0;\ v(D_3)=0.7;\ v(D_4)=0.8;\ v(D_5)=1;\ v(D_6)=0.95;\ v(D_7)=0.82;\ v(D_8)=0.7;$
$v(D_9)=0.6;\ v(D_{10})=0.5$

7. Use of Data Mining and Web Usage Mining

Techniques of Data Mining and Web Usage Mining [8] are widely applied now. In a recommendation system for choosing optional disciplines and learning materials to them these methods can be used for solving the following tasks:

- discovering which disciplines are being chosen the most frequently by students of other faculties;
- discovering which patterns of behavior cause problem situations the most frequently;
- elaborating recommendations by analogy with known cases;
- analysis of situations when disciplines fail for reducing risks of such situations;

- discovering how often a student follows recommendations or declines them;
- discovering to which extent a student is satisfied with his or her choice.

8. Operational environment of the framework

Besides techniques mentioned above there are many other approaches to building recommendation systems, e.g. for e-learning and for choosing the most appropriate disciplines. As a general rule, it is practically impossible to say beforehand which of them gives the best results. Just the same, it is very hard to choose optimal parameters of a certain method. For this reason, we develop a flexible environment for model support which would facilitate choosing a model suitable for the given situation, adding new models and techniques for dealing with them, combining existing models and exploring their effectiveness.

So the models should be declaratively described, parameterized, manageable and be adjustable artifacts. They should be categorized by levels. The whole environment is built on the base of some network of models. The nodes of this framework correspond to the models, and the links correspond to differences between them.

9. Conclusions

In order to build a recommendation system for choosing the most appropriate learning materials and disciplines, many approaches can be applied; some of them are mentioned in this paper. Each approach comprises specific concepts, models and techniques having different relations with each other. It is practically impossible to predict which of them would be more suitable for any particular situation. Therefore we suggest that the recommendation system should be based on some flexible environment of a model support, and we regard possible ways of creating such an environment. This environment should be based on a bank of specific models and open for enhancement.

This approach can be used not for e-learning only but for many other kinds of recommendation systems as well.

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View of Models of Multiple Valuable Boolean Functions as Well as Implementation in Cryptographic Reflections

Abdukadirov Bakhtiyor, Umarov Shuxratjon

Fergana branch of TUIT, Fergana, Uzbekistan
baxtiyor.uz@bk.ru, Sht003@inbox.uz

Abstract. Effective methods of modeling of Boolean function by multiple-valued property are given in the article. These methods allow modeling of crypto permanent transformations of algorithms and effective realization in hardware.

Keywords. Cryptography, microprocessor, microcontroller, codeprocessor, encryption, decoding, algorithm, Boolean function, cryptographically secure, symmetric, function chart.

1. Introduction

Nowadays in the fast paced developed information technologies and many-sided developing condition the security support of the information exchange cryptographic methods in the information – communication networks require the usage of the cryptographically secure encryption [1-6].

In this case, effective methods of Boolean function modelling which has the characteristic of the validity table of the multiple valuation are created, these methods are effectively used in the cryptographically secure algorithm modelling and hardware innovation.

2. Main body

Encryption is made by the general case of the algorithm reflection $GF(2)^n = \{x = (x_1, x_2, ..., x_n) \in X : x_i \in \{0;1\}\}$ by the sequence of one function of the space elements $GF(2)^m = \{y = (f_1, f_2, ..., f_m) \in Y : f_i \in \{0;1\}\}$ by exchanging with the space elements and they are represented as a Boolean function as following [4,5]:

$$Y = f(X) : GF(2)^n \to GF(2)^m \quad (1)$$

There are $f(x) = \{f_1(x), f_2(x), ..., f_m(x)\}$, $x_i, f_i \in GF(2)$, notably $x_i, f_i = \{0;1\}$.

For the support of the hardware for the effective, comfortable and cosy creation, Boolean functions are composed in order to define the key exchange through tables (Table 1).

Algebraic standard form for the Boolean functions expressions are written as following:

$$f(x) = a_0 \oplus \sum_{1 \le i \le n} a_i x_i \oplus \sum_{1 \le i_1 < i_2 \le n} a_{i_1 i_2} x_{i_1} x_{i_2} \oplus ... \oplus \sum_{1 \le i_1 < ... < i_2 \le k} a_{i_1 ... i_k} \oplus ... \oplus a_{12..n} x_1 x_2 ... x_n \quad (2)$$

There are $x \in GF(2)^n$ and $a \in GF(2)$.

Table 1. Validity table of the Boolean functions

$x_1\ x_2 \ldots\ x_{n-1}\ x_n$	f_1	f_2 ...	f_{n-1}	f_n
0 = 0 0 … 0 0	$S_0 = S_1(0)$	$S_2(0)$ ...	$S_{n-1}(0)$	$S_n(0)$
1 = 0 0 … 0 1	$S_1 = S_1(1)$	$S_2(1)$ ...	$S_{n-1}(1)$	$S_n(1)$
…	…			
2^n-2 = 1 1 … 1 0	$S_{2^n-2} = S_1(2^n-2)$	$S_2(2^n-2)$ ...	$S_{n-1}(2^n-2)$	$S_n(2^n-2)$
2^n-1 = 1 1 … 1 1	$S_{2^n-1} = S_1(2^n-1)$	$S_2(2^n-1)$ ...	$S_{n-1}(2^n-1)$	$S_n(2^n-1)$

Each expression f_i of the Boolean functions which suit the Validity table is made up for the single column . f_i for "1" (real) variable quantities, consist of conjunction terms which are added with the $\oplus$ function, variable itself is "1", variable negative is $\overline{x_i}$ suit "0" term [5].

Encryption is taken as the expression of the general algorithms reflection (1) $n = m$ mutually has characteristic of the single term. When the Validity table has the ability of single term, their practical implementation can be seen as the following example.

Let's above mentioned (1) reflection $n = m = 4$ case $Y = f(X)$: $GF(2)^4 \to GF(2)^4$ validity table is given (Table 2).

Table 2. Boolean functions validity table in the case of $n = m = 4$

$x_1\ x_2\ x_3\ x_4$	$f_1\ f_2\ f_3\ f_4$
0 = 0 0 0 0	4 = 0 1 0 0
1 = 0 0 0 1	15 = 1 1 1 1
2 = 0 0 1 0	3 = 0 0 1 1
3 = 0 0 1 1	0 = 0 0 0 0
4 = 0 1 0 0	9 = 1 0 0 1
5 = 0 1 0 1	12 = 1 1 0 0
6 = 0 1 1 0	13 = 1 1 0 1
7 = 0 1 1 1	10 = 1 0 1 0
8 = 1 0 0 0	8 = 1 0 0 0
9 = 1 0 0 1	7 = 0 1 1 1
10 = 1 0 1 0	6 = 0 1 1 0
11 = 1 0 1 1	2 = 0 0 1 0
12 = 1 1 0 0	1 = 0 0 0 1
13 = 1 1 0 1	11 = 1 0 1 1
14 = 1 1 1 0	5 = 0 1 0 1
15 = 1 1 1 1	14 = 1 1 1 0

This validity table has the mutual single term characteristic, notably numbers from 1 to 15 are suited to their mixed sequence single term. That's why Boolean function models which are suitable for validity table are expressed as following:

$$f_1 = (\overline{x}_1\overline{x}_2\overline{x}_3x_4) \oplus (\overline{x}_1x_2\overline{x}_3\overline{x}_4) \oplus (\overline{x}_1x_2\overline{x}_3x_4) \oplus (\overline{x}_1x_2x_3\overline{x}_4) \oplus$$
$$\oplus (\overline{x}_1x_2x_3x_4) \oplus (x_1\overline{x}_2\overline{x}_3\overline{x}_4) \oplus (x_1x_2\overline{x}_3x_4) \oplus (x_1x_2x_3x_4);$$

$$f_2 = (\bar{x}_1\bar{x}_2\bar{x}_3\bar{x}_4) \oplus (\bar{x}_1\bar{x}_2\bar{x}_3x_4) \oplus (\bar{x}_1x_2\bar{x}_3x_4) \oplus (\bar{x}_1x_2x_3\bar{x}_4) \oplus$$
$$\oplus (x_1\bar{x}_2\bar{x}_3x_4) \oplus (x_1\bar{x}_2x_3\bar{x}_4) \oplus (x_1x_2x_3\bar{x}_4) \oplus (x_1x_2x_3x_4);$$

$$f_3 = (\bar{x}_1\bar{x}_2\bar{x}_3x_4) \oplus (\bar{x}_1\bar{x}_2x_3\bar{x}_4) \oplus (\bar{x}_1x_2x_3x_4) \oplus (x_1\bar{x}_2\bar{x}_3x_4) \oplus$$
$$\oplus (x_1\bar{x}_2x_3\bar{x}_4) \oplus (x_1\bar{x}_2x_3x_4) \oplus (x_1x_2\bar{x}_3x_4) \oplus (x_1x_2x_3x_4);$$

$$f_4 = (\bar{x}_1\bar{x}_2\bar{x}_3x_4) \oplus (\bar{x}_1\bar{x}_2x_3\bar{x}_4) \oplus (\bar{x}_1x_2\bar{x}_3\bar{x}_4) \oplus (\bar{x}_1x_2x_3\bar{x}_4) \oplus$$
$$\oplus (x_1\bar{x}_2\bar{x}_3x_4) \oplus (x_1x_2\bar{x}_3\bar{x}_4) \oplus (x_1x_2\bar{x}_3x_4) \oplus (x_1x_2x_3\bar{x}_4);$$

By giving samples to the taken Boolean function models, through direct calculation the creation of the 2nd table can be seen.

Now cases $n \neq m$, $n = 3$ and $m = 2$ will be scrutinized (Table 3). Boolean function models in the table have the following expressions:

$$f_1 = (\bar{x}_1\bar{x}_2\bar{x}_3) \oplus (\bar{x}_1\bar{x}_2x_3) \oplus (x_1\bar{x}_2x_3) \oplus (x_1x_2\bar{x}_3);$$

$$f_2 = (\bar{x}_1\bar{x}_2x_3) \oplus (\bar{x}_1x_2x_3) \oplus (x_1\bar{x}_2\bar{x}_3) \oplus (x_1\bar{x}_2x_3);$$

Table 3. Boolean functions validity table in the case of $n = 3$, $m = 2$

x_1 x_2 x_3	f_1 f_2
0 = 0 0 0	2 = 1 0
1 = 0 0 1	3 = 1 1
2 = 0 1 0	0 = 0 0
3 = 0 1 1	1 = 0 1
4 = 1 0 0	0 = 0 0
5 = 1 0 1	3 = 1 1
6 = 1 1 0	2 = 1 0
7 = 1 1 1	0 = 0 0

Table 4. In cases $n = 3$, $m = 2$ indirect reflection towards Boolean functions.

f_1 f_2	x_1 x_2 x_3
2 = 1 0	0 = 0 0 0
3 = 1 1	1 = 0 0 1
0 = 0 0	2 = 0 1 0
1 = 0 1	3 = 0 1 1
0 = 0 0	4 = 1 0 0
3 = 1 1	5 = 1 0 1
2 = 1 0	6 = 1 1 0
0 = 0 0	7 = 1 1 1

Obviously, indirect reflection for the table 3 reflection is given in the table 4. Boolean function models on the basis of the (1) expression reflection are as following:

$$x_1 = \bar{f}_1 f_2 \oplus f_1 f_2 \oplus f_1 \bar{f}_2 \oplus \bar{f}_1 \bar{f}_2 ; \qquad x_2 = \bar{f}_1 f_2 \oplus f_1 \bar{f}_2 ;$$

$$x_3 = \bar{f}_1 f_2 \oplus f_1 f_2$$

However, when the entrance quantities of the table 4 are given to Boolean functions suitable exit quantities will not be appeared. The reason for this is the disorder of the single term suitability. When the such kind of single quantity is not suitable in the reflection validity table, the way of the solution for the problem of the Boolean function models creation can be viewed as following (table 5).

On the basis of the previous rule Boolean function which represents the x_1 column is created:

$$x_1 = \bar{f}_1 f_2 f_3 \oplus f_1 f_2 f_3 \oplus f_1 \bar{f}_2 f_3 \oplus \bar{f}_1 \bar{f}_2 f_3 .$$

Table 5. Indirect reflection of the Boolean functions which do not meet the expectation of the mutual single quantity suitability: $f_3 = x_1$

f_1 f_2	$f_3 = x_1$	x_1 x_2 x_3
2 = 1 0	0	0 = 0 0 0
3 = 1 1	0	1 = 0 0 1
0 = 0 0	0	2 = 0 1 0
1 = 0 1	0	3 = 0 1 1
0 = 0 0	1	4 = 1 0 0
3 = 1 1	1	5 = 1 0 1
2 = 1 0	1	6 = 1 1 0
0 = 0 0	1	7 = 1 1 1

As previous one, in the table 6, Boolean function modelling which represents x_2 column mutual similarity is destroyed.

In this case modeling process is done as the previous rule, however quantity which is suitable when the similar entrance quantities are repeated is participated as a single addition in the Boolean function models, notably

$$x_2 = \bar{f}_1 \bar{f}_2 f_3 \oplus \bar{f}_1 f_2 f_3 \oplus f_1 \bar{f}_2 f_3 .$$

Table 6. Indirect reflection table of Boolean function of the cooperative single quantity $f_3 = x_2$

f_1 f_2	$f_3 = x_2$	x_1 x_2 x_3
2 = 1 0	0	0 = 0 0 0
3 = 1 1	0	1 = 0 0 1
0 = 0 0	1	2 = 0 1 0
1 = 0 1	1	3 = 0 1 1
0 = 0 0	0	4 = 1 0 0
3 = 1 1	0	5 = 1 0 1
2 = 1 0	1	6 = 1 1 0
0 = 0 0	1	7 = 1 1 1

Cooperative single quantity suitability is destroyed in the Boolean function modeling which represents the x_3 column in the table 7. The suitable expression of the Boolean function model has the similar characteristic as the previous validity table Boolean function model is as following: $x_3 = f_1 f_2 f_3 \oplus \bar{f}_1 f_2 f_3 \oplus \bar{f}_1 \bar{f}_2 f_3$

Table 7. Indirect reflection table of Boolean function of the cooperative single quantity: $f_3=x_3$

f_1 f_2	$f_3= x_3$	x_1 x_2 x_3
2 = 1 0	0	0 = 0 0 0
3 = 1 1	1	1 = 0 0 1
0 = 0 0	0	2 = 0 1 0
1 = 0 1	1	3 = 0 1 1
0 = 0 0	0	4 = 1 0 0
3 = 1 1	1	5 = 1 0 1
2 = 1 0	0	6 = 1 1 0
0 = 0 0	1	7 = 1 1 1

3. Conclusion

As the reflection vector *n* and *m* measures are increased Boolean functions quantities will be increased. By this, following conclusions can be concluded:

- "1" (real) terms' quantity which is equal to validity table f_i (i=1,2,…,n) will find out the addition quantity of the f_i expression;
- If "1" quantities which are equal to f_i (i=1,2,…,n) columns $f_i \equiv 0$;
- If $\overline{x_i} = x_i \oplus 1$ exchanges of each f_i (i=1,2,…,n) boolean functions expression are done (2), can take the view of the algebraic normal form as the formula;
- The table reflection of the information compression given possibility, after simplifying and exchange with each f_i (i=1,2,…,n) expressions $\overline{x_i} = x_i \oplus 1$, as (2) formula addition quantities can be fixed.

As a conclusion it can be mentioned, reflection entrance and exit vectors measures $n \neq m$, even in the any fixed quantities, Boolean function model can be created with the help of aforementioned methods.

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Dekker and Peterson Algorithms, Solution of the Problem "About Synchronization of Shooters"

Abdukadirov Bakhtiyor [1], Murtazaev Sherzod [2], Khasanov Kamol [3]

[1] Fergana branch of TUIT, Fergana, Uzbekistan
baxtiyor.uz@bk.ru

[2] Karshi branch of TUIT, Karshi (Uzbekistan)
sherzod_tmi@mail.ru

[3] Samarkand branch of TUIT, Samarkand, Uzbekistan
jon_nesh@bk.ru

Abstract. The article deals with the algorithms Dekker and Peterson, in this paper was described to analyze these algorithms and their advantages and disadvantages, as well as their application to solve the problem of critical intervals, the solution of the problem of synchronization of the shooters were covered by processes and their interaction.

Keywords. Description of the algorithm, the algorithm Dekker and Peterson, mutual exclusion of critical intervals, the main advantages of Decker's algorithm, graphical solution of the arrows.

1. Introduction

In certain operating systems, there are co-operating processes, which can be used together for a common data store. Each of the processes have the ability to read any of the shared data store and write back information. Storage - is the area in the main memory in the kernel data structure or file sharing. There are situations in which several processes are simultaneously read or write data, and depending on which of them was the first output end result. Such situation is called race condition.

To avoid contention, there are various methods, one of the main problems is to prevent this and any other situations, to be associated with the use of competitive memory and files, that is, prohibition of simultaneous reading and writing data shared by more than one process. In other words, mutual exclusion is required, namely, at a time when one process is using the common data, another process will be prohibited from doing this. Selection of a suitable operation that implements mutual exclusion, is an important aspect of the operating system development.

The first, who developed the software solution of mutual exclusion problem that does not require strict alternation, was a Danish mathematician Dekker. In 1981, Peterson invented more than a simple algorithm for mutual exclusion and option Decker was considered as a old fashioned.

2. Dekker Algorithm

Dekker's algorithm is the first known exact solution of mutual exclusion without the interrupt. The name of the algorithm associated with the Dutch mathematician Theodor Decker, who has developed a solution to this problem. The algorithm allows two threads to share a one-time resource without conflict, using only shared memory for communication.

Dekker's algorithm has the following limitations:

The algorithm is designed strictly on 2 processes;

While waiting for a resource, process wasting CPU time, since it is not removed from the queue for service;

When you try to hit simultaneously two processes in the critical section, the algorithm allows to enter only one process;

If you find one of the processes in the critical section, the other process will wait.

It should be noted that the use of these algorithms in real time operating system is not desirable due to the fact that the process is not blocked is removed from service and needlessly consumes CPU time.

Dekker's algorithm is based on the 3 variables: WP1 (process 1), WP2 (process 2) and ALL.

If the first process wants to enter its critical range, the variable WP2 evaluates to TRUE, ie variable QUEUE shows whose it is now right to enter into the critical interval.

If WP1 = TRUE, and WP2 = FALSE, then regardless of the value of the variable QUEUE marks WP1.

If WP1 and WP2 = TRUE = TRUE, then the next process is executed, which is determined by the value of the variable QUEUE.

After completing its execution process resets its execution flag to FALSE, and change the value of the variable QUEUE is reversed. The range of values of the variable QUEUE usually ranges from [0, 1] or [1, 2]. The value of the variable QUEUE is essentially the same flag.

```
Begin integer C1, C2, and foremost;
C1: = 0; C2: = 0; queue = 1;
begin
PROCESS_1: begin C1: = 1;
do while (C2 = C1)
 if (queue = 2) then
begin
C1: = 0;
do while (queue = 2);
end;
end;
/ * Critical section PROCESS_1 * /
C1 = 0;
all = 2;
/ * * The rest of the process /
end;
PROCESS_2: begin C2: = C1;
do while (C1 = 1);
if (queue = 1) then
begin
C2: = 0;
do while (place = 1);
end;
C2 = 1;
end;
end;
```

/ * Critical section PROCESS_2 * /
C2 = 0;
queue = 1;
/ * * The rest of the process /
end;
end;
end.

Dekker's algorithm provides a mutual exclusion, the impossibility of occurrence of deadlock or starvation. (Deadlock - a situation in which several processes will be waiting in the state of infinite resources occupied by these processes (themselves); starvation - this hang-up processes).

One of the advantages of this algorithm is that it does not require special Test-and-set instructions (atomic read operation, modification and writing), so it is easily portable to different programming languages and computer architecture. Disadvantages can be called its applicability to the case of only two processes and the use of Busy waiting instead of suspending the process (using busy waiting suggests that the processes need to spend a minimum amount of time in the critical section).

Thus, the algorithm Dekker useful in cases when you use a limited number of processes, with the increase in the number of processes will grow in proportion to the number of used items (Pr1 ..., Prn), as well as the number of code snippets for permission to enter a critical section for each of the processes.

To simplify the use of Dekker's algorithm in the case of multiple processes in 1981, Peterson proprietary algorithm was proposed, allowing to organize the entry in order into the critical section of an unlimited number of processes.

3. Algorithm PETERSON

Peterson's algorithm - a software algorithm for mutual exclusion flows without interruption prohibition. It was proposed in 1981 by Harry Peterson of the University of Rochester (USA). Peterson's algorithm is based on an algorithm Dekker went. Originally, the algorithm was formulated for 2-in-line case, but it can be generalized to any number of threads. The algorithm is not based on the use of processor instructions that prohibit interrupt lock the memory bus, there are only shared variables memory and input waiting loop in the critical section of code, so called conditional algorithm software. Peterson's algorithm takes into account the absence of atomicity in the operations of reading and writing of variables and can be used without using the interrupt control commands.

The algorithm works as following: each process has its own variable flag [i] and the total variable turn. Keeping all variables occurs in shared memory. The fact of the resource capture is stored in a variable flag, variable turn - number of resource capture process.

When executed prologue critical section, Pi process declares its readiness to implement the critical area and immediately offers to another process to proceed to its implementation. In the case where both processes come to the prologue at the same time, they both declare their readiness to offer each other and run. In addition, each proposal should be clear to each other. Thus, the work in the critical area will continue to process until the last sentence is made.

flag [0] = 0
flag [1] = 0
turn = 0
P0: flag [0] = 1 P1: flag [1] = 1
turn = 1 turn = 0

while (flag [1] && turn == 1); while (flag [0] && turn == 0);
// // Forward forward
// Beginning of a critical section // beginning of a critical section
... ...
// It // end of its end
flag [0] = 0, flag [1] = 0

First, the process sets the busy flag, then - number neighbor process. After these steps, each of the processes included in the standby cycle. Exiting the loop occurs if the busy flag is set and the process number corresponds to neighbor.

Another embodiment of the Peterson's algorithm:

```
void mut_excl (int me / * 0 or 1 * /)
{
static int loser;
static int interested [2] = {0, 0};
int other; / * Local variable * /
other = 1 - me;
interested [me] = 1;
loser = me;
while (loser == me && interested [other]);
/ * Critical section * /
interested [me] = 0;
}
```

Peterson algorithm developed in 1981, consists of two procedures written in C

```
#define FALSE 0
#define TRUE 1
#define N 2
int turn; int interested [N];
void enter_region (int process)
{
int other;
other = 1-process;
interested [process] = TRUE;
turn = process;
while (turn == process && interested [other] == TRUE) {} // Empty cycle
}
void leave_region (int process)
{
interested [process] = FALSE;
}
```

When you try to access a critical resource enter_regian process calls the function, passing it in your room. If a critical resource is already busy, the function will enter the so-called "tight" loop waiting until the resource will not be released. Release of the resource produced function leave_regian. This algorithm is based on the idea of so-called active standby, ie constant state of self-survey variable lock while in a "taut" cycle. The ineffectiveness of the main algorithm is that spent a lot of CPU time to the active standby mode while employment resources from other processes.

4. Challenge "synchronization Arrow"

Formulation of the problem

The initial data for the task: there is a chain of riflemen and officers. Everyone who is in the chain of soldiers can only communicate with their neighbors to the right and the left. The officer placed on the flank of the chain and can give commands only in extreme arrow chain. The total number of shooters in the chain of each of the shooters is unknown. Required to provide a simultaneous volley of all shooters after the command chain officer.

Solution algorithm

This problem is solved by means of an automaton model of the behavior of the arrow. During the work program - the arrows can be in one of the following states: Sleep (I'm sleeping); Direct account (My index is *); Count (I'm ready); The discovery of fire (Fire!). The state of the direct account and reverse arrows by switching in the event of changes in the state of neighboring shooters. The state takes direct account arrow change the state of the neighbor to the left, into a state of change in the countdown takes neighbor to the right.

The full algorithm is described by an automaton model shown in Figure 1.:

q0 - sleep state «I'm sleeping». If the shooter left flank and ordered «Fire!», The it goes to the next state - q1.

q1 - left-flank gunner, remembers his room and immediately informs his right neighbor (index→R) under the condition (the arrows should not be right flank) the existence of the right neighbor (index + 1). ! If the neighbor to the right right-flank (index + 1), the arrow goes to the state - q2.

if left to a neighbor (index-1) (the arrows are not left flank), it informs the arrow right-flank his room, and the next second he meets him «I'm ready» (index-1→L) and proceeds to the opposite bank.

after the countdown (index = 0), the shooter starts firing, and then goes to sleep q0 until further notice.

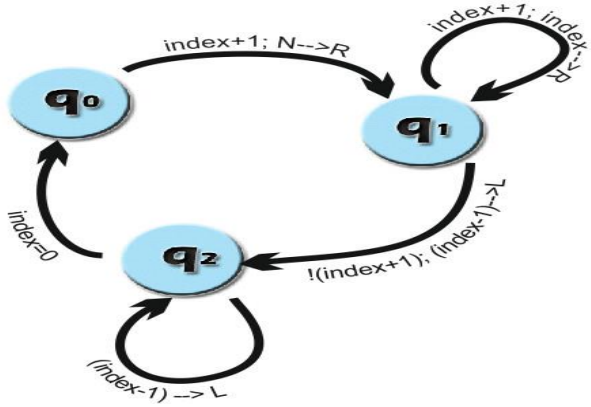

Fig.1. Automaton model of behavior arrow

Software implementation tasks

This code snippet creates a process of "arrows":

```
int main (int argc, char * argv []) {
hWatchdog = CreateSemaphore (NULL, 0, 1, "watchdog");
```

```
// Starts the process of shooters
for (int i = 0; i <COUNT; i ++) {
processes [i] = startProcess (i);
}
Creation of "officer" of the process:
PROCESS_INFORMATION startProcess (int index) {
std :: stringstream ss;
ss << "Rifleman.exe" << index << "" << COUNT;
STARTUPINFO cif;
ZeroMemory (& cif, sizeof (STARTUPINFO));
PROCESS_INFORMATION pi;
CreateProcess (NULL, (LPTSTR) ss.str (). C_str (), NULL,
NULL, FALSE, CREATE_NEW_CONSOLE,
NULL, NULL, & cif, & pi);
return pi;
}
The interaction of two processes - the "officer" and "arrows":
HANDLE hFirstRiflemanSemaphore =
OpenSemaphore (SEMAPHORE_ALL_ACCESS, FALSE, "rifleman0");
ReleaseSemaphore (hFirstRiflemanSemaphore, 1, NULL);
Destruction of "arrows" of the process:
for (int i = 0; i <COUNT; i ++) {// terminate processes shooters
TerminateProcess (processes [i] .hProcess, NO_ERROR);
}
return 0;
Destruction of "officer" of the process:
while (1) {
...
else if (GetAsyncKeyState (VK_ESCAPE)) {
break;
}
```

Figure 2 displays a graphical solution of the arrows.

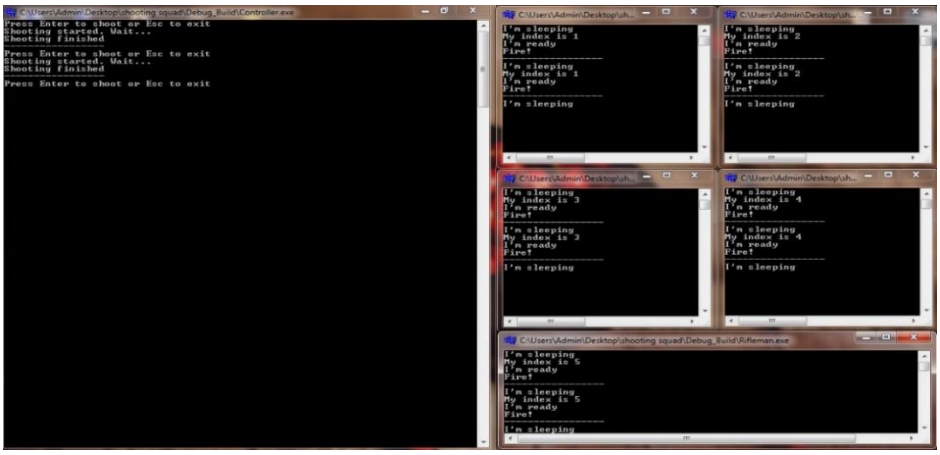

Fig.2. Detail of the work program

5. Conclusion

Dekker's algorithm - the first known correct solution to the problem of mutual exclusion in competitive programming. It allows two threads to share execution unshareable resource without conflict, using only shared memory for communication. But Dekker's algorithm is inconvenient in the case of more than 2 processes more comfortable will be a modification known as Peterson's algorithm. One advantage of the algorithm is that it does not require special Test-and-set instructions and therefore it is easily portable to different programming languages and computer architecture. Thus, the algorithm optimizes the performance of multi-tasking operating systems and multi-processor computing.

Modern operating systems provide synchronization primitives which are more general and flexible in comparison with the algorithm Dekker. However, it should be noted that in the absence of real competition between the two processes, the entry operation in the critical section and exit from it, would be very effective when using this algorithm.

The task of "Synchronization shooters" was solved during the operation. It was demonstrated by the interaction of two processes using semaphores, namely the interaction process of "officer" and "arrows" of the process.

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Delimitation Control with Using Priority Queuing Model

Abdukhalil Ganiyev, Sherzod Gulomov, Bakhtiyor Babamukhamedov

A. Temur street 108, Tashkent, Uzbekistan
ganiyev@tuit.uz , sherzod.gulomov@rambler.ru, abbts@mail.ru

Abstract. The paper considers stochastic character of the process functioning of computer networks. Model control of packet switching, which is carried out by absolute priority and ejecting mechanisms is proposed. Scheme of priority querying system class and graph marked states of the system are shown. The delimitation control, described the priority model of QS is analyzed.

Keywords. Queuing theory (QT), queuing systems (QS), packet traffic, bandwidth, non-priority, firewall, Markov theorem, Kronecer delta.

1. Introduction

Applied in engineering practice networking technologies are very diverse. They are ahead in the development and practical implementation of the development of adequate analytical models and their theoretical justification. The main factor complicating the modeling of network traffic is the random nature of packet loss in virtual connections. The stochastic character of computer networks and the structure formed with virtual connections determines the possibility of using their analytical methods and models of queuing theory (QT). However, analysis of network processes on the basis of single-threaded and single-phase models of queuing systems (QS), characteristic of the early stage of the theoretical analysis of network interactions, nowadays no longer adequately reflect the characteristics of modern computer networks.

2. Scheme of priority QS class

The proposed model of packet switching control is carried out by means of two mechanisms:

- firstly, the absolute priority of service of packet traffic generated by authorized data;
- secondly, the probability of the ejecting mechanism, which is provided with a buffer memory delimitation control telematics devices.

As a result, the priority type packets with a certain probability $0 \leq \alpha \leq 1$ able to eject the buffer firewall non-priority packets. By selecting the value α it is appeared possibility configure algorithm of the adaptive traffic control. This allows us to effectively redistribute available for different virtual connections bandwidth, controlling, thereby mutual bandwidth priority and non-priority data flows.

Consider a single-channel QS limited storage $k(1 < k < \infty)$, into two independent elementary flow applications and intensity λ_1 and λ_2. Possible that service the duration of which receives input is distributed according to the same exponential law. These durations are mutually independent. Service intensity is denoted by μ.

The first type of packets is given absolute priority in service. While all priority service requests have been processed, the second type of packets is in the queue. Newly received

requests priority interrupt handling non-priority and replacing them in the drive (if there are empty area for waiting) or outside the system (if there are not empty area). Removed from service the packets are connected the queue of non-priority claims.

The storage device is a common, empty area for waiting packed is available for any new incoming request [1]. Dynamically formed two separate queues packets, their total length is limited storage capacity $(\kappa - 1)$. Unlike typical priority QS system under consideration is equipped with a probabilistic ejector mechanism. Priority packet, caught all area for waiting is occupied at the time of processing another priority packet, with a given probability and displaces one of the storage of low-priority packets and takes his place. Extruded packet is lost.

Scheme of described QS is shown in figure 1. Through $a_i(\tau)$ and $b_i(\tau)$ are marked distribution laws, respectively, the interval between the requirements and service time for the i −th packet flows. In the absence of the ejecting mechanism $(a = 0)$ and at the determined ejection $(a = 1)$ are similar systems.

Here, the ejecting mechanism combined with a relative, rather than absolute, as in the present case, the priority.

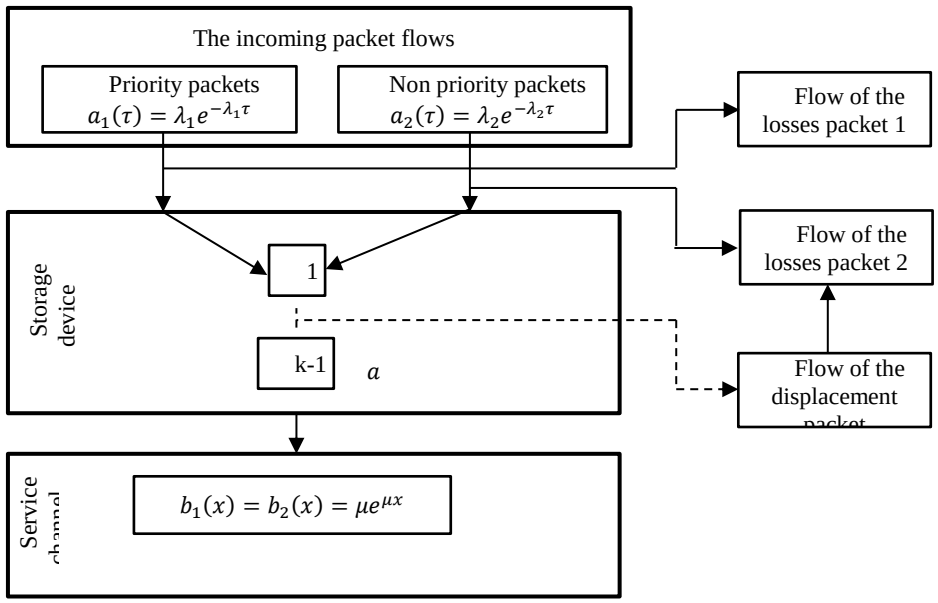

Fig.1. Scheme of priority QS class $\frac{\overline{M_2}/M}{\frac{1}{k}}/f_2^1$

Total incoming QS flow is shown in figure 2, which is very simple with intensity $\lambda = \lambda_1 + \lambda_2$. Apart from the differences between the types of requirements and track only the total number of packets [2] in the system, such a simplified single threading model would have a shorthand notation for D.Kendall $M/M/1/k$.

The special modification of the Kendall indication system, is intended for priority QS. In the modified system the overall structure of symbols and the meaning of some of its products are preserved, but each item is used vector symbols. Furthermore, a supplementary symbol f_i^j, where i indicates the priority type (0 - no priority 1- relative, 2- absolute) and on the j −type ejecting (0 - without ejecting, 2 - deterministic ejecting).

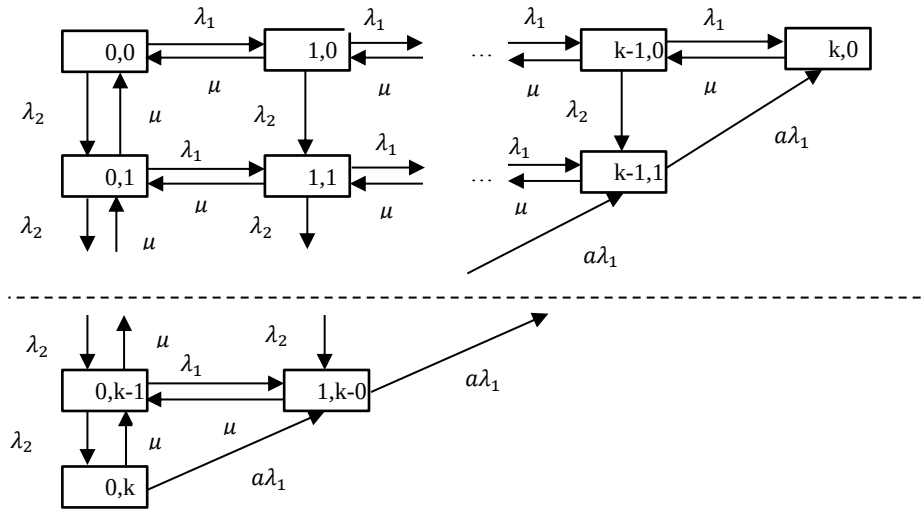

Fig.2. Graph marked states of the system $\frac{\overrightarrow{M_2}/M}{\frac{1}{k}}/f_2^1$

In the original system, the value of $y = 1$ was not involved. It should be used to indicate the probability ejector mechanism, as an intermediate between variants $y = 0$ and $y = 2$. With this addition to the rules of QS, described in figure 1 must be assigned to the class $\overrightarrow{M_2}/M/1/k/f_2^1$.

The history of the research of single-channel two-flow priority systems goes back more than half a century, but only now being studied probabilistic ejecting mechanism (in conjunction with the relative priority for QS class $\overrightarrow{M_2}/M/1/k/f_1^1$. However, for typical models the ejecting mechanism ($j = 0$ and $j = 2$) is basically the problem is solved.

Typical models of the class are presented $\overrightarrow{M_2}/\overrightarrow{M_2}/1/k/f_2^0$, and $\overrightarrow{M_2}/\overrightarrow{M_2}/1/k/f_2^2$ and analysis of systems $\overrightarrow{M_2}/\overrightarrow{M_2}/1/\vec{k}/f_2^0$ and $\overrightarrow{M_2}/\overrightarrow{M_2}/1/\vec{k}/f_2^2$ with separate queues. The same structure of the system, but with a finite number of sources load l, denoted as $\overrightarrow{M_2}/M/1/k/l/f_2^2$. There's also considered one more a more complex model $\overrightarrow{M_2}/M/1/\vec{k}/\vec{l}/f_2^2$ separate queues and load sharing on the types of requirements sources. In recent years, this type of queuing models and their various generalizations are widely used in the theoretical analysis of real Internet systems.

3. The task of A. Bondi

Here, the typical model with a common queue $\overrightarrow{M_2}/M/1/k/f_2^0$ and separate queues $\overrightarrow{M_2}/M/1/\vec{k}/f_2^0$ is compared partially separated queues, while maintaining some of the general storage device. The task of optimal allocation of storage device between its fully accessible and not accessible parts is solved. As shown probabilistic ejecting mechanism is a more convenient and efficient in comparison with other well-known by the publications, the mathematical models ejecting. It adequately describes the actual processes of network traffic and thus is quite simple in terms of mathematical repose.

4. Research of delimitation control, described the priority model of QS

It characterizes the state of the system two-dimensional process $\vec{N}(t) = \{N_1(t), N_2(t)\}$, where $N_i(t)$ −the number of requests i −type in the system at time t. Under the above assumptions, the process $\vec{N}(t)$ is a Markov process and will be developed in the phase space.

$$\Omega = \{(n_1, n_2): n_l \geq 0, n_2 \geq 0, n_1 + n_2 \leq k\} \quad (1)$$

On the Markov [3] theorem process $\vec{\mathrm{N}}$ is ergodic. The final state probabilities denoted through $\mathrm{p_{ij}}(\mathrm{i} = 0, \mathrm{k}; \mathrm{j} = 0, \mathrm{k} - \mathrm{i})$.

According to the usual rules of Kolmogorov system equations, it gets

$$-\left[\lambda_1\left(1 - \delta_{j,k-i}\right) + \alpha\lambda_1\left(1 - \delta_{j,k}\right)\delta_{j,k-i} + \lambda_2\left(1 - \delta_{j,k-i}\right) + \mu\left(1 - \delta_{i,0}\delta_{j,0}\right)\right]p_{ij} +$$

$$\mu p_{i+1j}, +\mu\delta_{i,0}p_{i,j+1} + \lambda_2 p_{i,j-1} + \lambda_2 p_{i-1,j} + \alpha\lambda_1\delta_{j,k-1}p_{i-1,j+1} = 0,$$

$$(i = 0, k; j = 0, k - i) \quad (2)$$

where $\delta_{i,j}$ denotes the Kronecer delta. The formula (2) must be solved together with the normalization condition.

$$\sum_{i=0}^{k}\sum_{j=0}^{k-i} p_{ij} = 1 \quad (3)$$

At sufficiently high k, corresponding to the real size of the firewall buffer, formulas (2) and (3) are bad-conditioned, and its direct numerical solution results in more processing errors. In this method, the problem reduces to the solution of an auxiliary system of linear algebraic equations of order $1/2k(k+1)$ with a triangular matrix.

In the case of $a < 1$ the method does not result in a closed analytical solution, but it gives a considerable gain in comparison with the method of recurrence relations. Also as when used in the method, the problem reduces to solving a system of linear equations with a triangular matrix, but the order of the system is reduced $1/2k(k+1)$ to $k+1$. This fact reduces the computational complexity and at the same requirements for accuracy allows it to cover a wider range of variation capacity of k buffer.

It is introduced the generating function of the final probabilities in the form.

$$G(u, v) = \sum_{i=0}^{k}\sum_{j=0}^{k-i} p_{ij}u^i v^j \quad (4)$$

The normalization condition (4) can be rewritten as

$$G(1,1) = 1 \quad (5)$$

This representation allows us to express the function G in terms of the probability of boundary conditions $\mathrm{p_{0,j}}$ and $\mathrm{p_{i,k-i}}$. With the help of special techniques can be excluded and the probability $\mathrm{p_{0,j}}$. If then it uses the arguments based on considerations of analytic functions of G, then the problem is reduced to solving a system of linear equations in the unknown $\mathrm{p_{i,k-i}}$.

First it is considered a simpler analytically solvable problem with deterministic ejector mechanism [4]. Analytical solvability of the problem calculating the probability of loss at $\alpha = 1$in the case of the relative priority remains valid at an absolute priority.

Assuming that $\alpha = 1$, after division of the numerator to μ it finds $G(u, v)$, that means utilization system type claims.

It is obtained the distribution of the number of priority requirements N_1.

It is presumed $q_n = P\{N_1 = n\}, (n = 0, k)$ and expressed the generating function $\mathrm{q_n}$ through G as:

$$G_1(u) = \sum_{n=0}^{k} q_n u^n = G(u,1) \quad (6)$$

Generating function (6) corresponds to a truncated geometric distribution

$$q_n = (1-p_1)p_1^n/(1-p_1^{k+1}),\ (n=0,k). \quad (7)$$

Knowing it, it is easy to find all the technical characteristics of QS, relating to priority applications. The main of them is the likelihood of network problems is probability the losses of the priority requests is $P_{loss}^{(1)}$. For a more detailed analysis of the priority traffic are also of interest:

- the average number of priority applications in system $\bar{n}^{(1)}$;
- the average length of the queue priority application is $\bar{n}^{(1)}{}_{queue}$;
- probability of expectation is $P_{expectation}^{(1)}$;
- the average number of channels occupied by these requests $\bar{n}_{request}^{(1)}$.

Now it is researched the total number of packets in the system $N = N_1 + N_2$.

It is defined the probability $r_n = P\{N = n\}$ and introduce them to the generating function $G_\Sigma(u) = \sum_{n=0}^{k} r_n u^n = G(u,u)$.

Assuming $v = u$ in (6), reducing $(u-1)$ and using together (7) is the identity concerning probability r_n, $G(0,0) = p_{0,0} = r_0, \sum_{i=0}^{k} p_{i,k-1} = r_k$, it is obtained for G_Σ presentation, where numeric parameters q_1, p_1, q_k should be respectively replaced by $r_0, p = p_1 + p_2, r_k$.

5. Conclusion

The mechanism of the priority processing packet traffic is researched, that allows split the network traffic on the number classes. Model network traffic in real scale time, which is serve cumbersome numerical solution of problems queuing theory is analyzed.

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Ways and Structural Model Protection to Service Information on the Corporate Notification Transmission Systems

Madjit Karimov, Sherzod Gulomov

A.Temur street 108, Tashkent, Uzbekistan
dr.mmkarimov@rambler.ru, sherzod.gulomov@rambler.ru

Abstract. The paper reviews the ways to protect the transmission of service information based on active monitoring users' workstations in the corporate notification transmission systems. Active monitoring users' workstations allow forbid to record service information to external media, block the transmission of information to external network addresses. Security model of service information in the corporate notification transmission systems is presented.

Keywords: Service information, Sensors modules, Sctive monitoring, External media, Terminal server, Typical information systems, Special information systems, Structural model.

1. Introduction

Nowadays, information and communication systems are the foundation of virtually all business processes in both commercial and government organizations. However, the widespread use of communication systems for the storage, processing and transmission of information leads to an exacerbation of the problems associated with their protection.

This is confirmed by the fact that over the past few years in the leading foreign countries, there is a tendency to increase the number of phishing attacks, which lead to significant financial and material losses. One of the most dangerous threats to official information is leaked stored and processed within the information and communication of sensitive information systems. All this makes us look more closely at possible channels of leak of service information, and offer a range of technical solutions to prevent data leakage.

2. Active monitoring systems of users' workstations

Active monitoring systems are specialized software designed to detect unauthorized activities of users connected, in particular, in an attempt to transfer proprietary information outside the controlled premises. Monitoring systems consist of the following components (see figure 1):

- sensors modules that are installed on users' workstations and to ensure the collection of information about events registered at these stations;
- data analysis module, collected by the sensors in order to detect unauthorized actions of users associated with the leak of service information;
- response module to identify unauthorized user actions;
- centralized management components of the monitoring system module.

Sensors monitoring systems installed on those workstations, where users work with service information. Based on the settings specified by the security administrator, system

sensors allow control user access to applications, service information, and impose restrictions on the actions that the user can perform with this information.

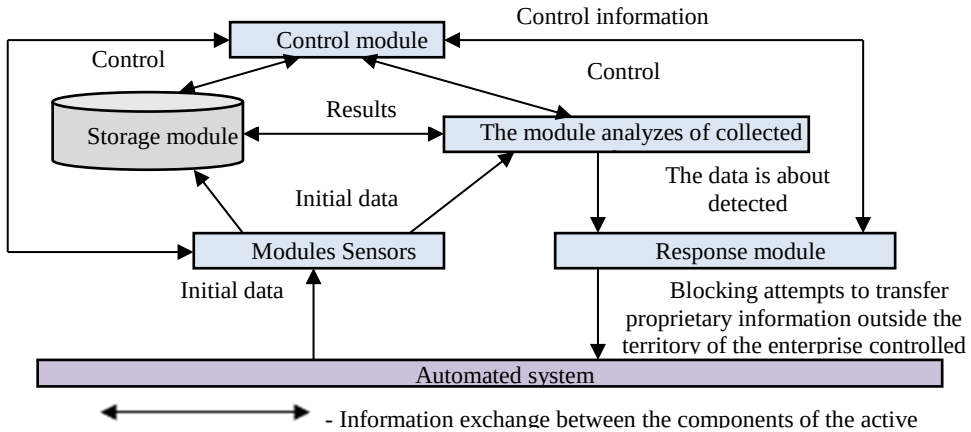

Fig.1. Typical architecture of the active monitoring of users' workstations systems

The advantage of the using monitoring systems is the possibility of creating a virtual isolated service data processing environment without physical separation separate automated system (AS) for using with restricted access data [1]. In addition, this type of system allows the software to limit the output data to external media, eliminating the need to physically remove the computer from the information recording devices, as well as the sealing ports and system units. However, the use of active monitoring systems entails the installation of additional software to each workstation, which could potentially lead to increased administrative complexity of the AS, as well as possible conflicts in the system software.

3. The isolated segment of terminal access to service information

Another way to protect against leakage of insider information is to provide access to official information the AS through the intermediate terminal servers. Under such an access scheme, a user first connects to a terminal server that is running all the applications necessary to work with the service information. The user in a terminal session starts these applications and start working with them as if they are installed on his workstation (see figure 2).

During operation in the terminal session user is sent only to the graphic work area of the screen image, while all service information with which it works, there remains only on the terminal server.

One such terminal server, depending on the hardware and software configuration, can simultaneously serve hundreds of users.

Practical use of technical solutions based on terminal server allows you to protect against unauthorized copying of proprietary information to external media due to the fact that all the information is not stored on workstations and terminal server.

Similarly, protected and unauthorized printing of documents. Print the document, the user can only using the printer installed in the terminal access segment. In this case, all the documents displayed on this printer can be registered in the prescribed manner.

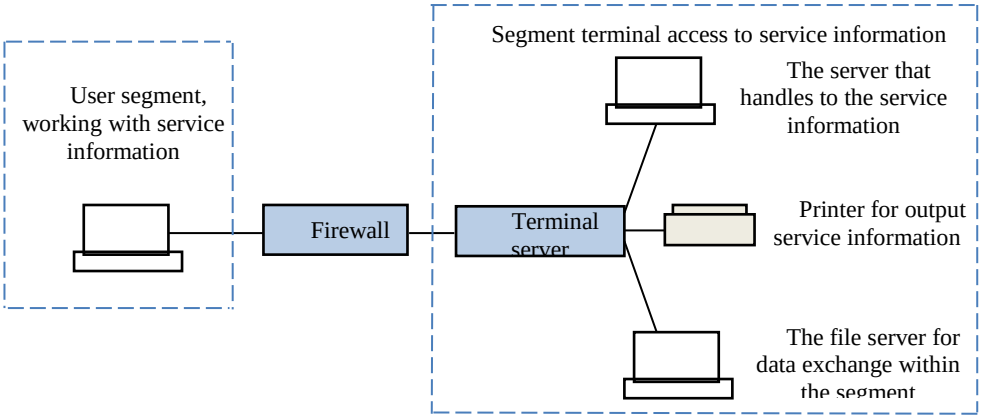

Fig.2. Installation scheme of terminal server to data service

Using a terminal server can also provide protection against the unauthorized transfer of service information over a network to an external server outside the territory controlled by the enterprise. This is achieved by filtering all data packets, directed outwardly segment terminal access, except those packets, that provide transmission workspace graphic images on the user display station [2]. Such filtering can be implemented using a firewall installed at access terminal segment conjugation with the rest of the AS.

In this case, all attempts to establish a connection to the Terminal Server on the Internet sites will be blocked. At the same time the workstation can have easy access to Internet resources. For exchanging information between users, working in the terminal sessions can be used a dedicated file server located in the terminal access segment.

4. The security model of service information in the corporate notification transmission systems

The organization works to ensure the security of sensitive information in its processing in the information systems involves the following steps:

1. Definition threats of service information during processing and formation on their basis threat model.
2. Development on the basis threats model of system protection of service information, overhead to neutralize the perceived threats to the use of methods and ways to protect proprietary information.
3. Checking of preparing tools protection of service information to use.
4. Providing persons, using means of protecting proprietary information, the rules work.
5. Registration persons, who have access to the service information in the information system.

Under developing the model security of service information necessary take into account the following inputs data:

- characteristic security service information, processed in the information system;
- the structure of the information system;
- availability connected to the information system of public communication networks and international information exchange networks;

- mode processing service information;
- mode of differentiation of users access rights information system;
- location technical tools of information system.

For a given characteristic security service information, processed in the information system, information systems are divided into typical and special.

Typical information systems - systems in which, the only information required to provide privacy.

Special information systems - systems in which, regardless of the need to ensure the confidentiality of information is required to provide at least one of the characteristics of the service information security.

Structural information systems can be:

- autonomy complexes of hardware and software tools, allocating for processing service information-automated workplaces (AW);
- AW complexes, combined into a single information system of communication devices without using remote access - local information system (LIS);
- AW complexes and LIS, united into a single information communications system using the remote access - distribution information system (DIS).

On availability to the networks of public communication and international networks of information exchange information systems are divided into system-single-user and multi-user.

In the delimitation of access rights to information systems users are divided into system - without restricting access rights and access rights [3]. Location hardware system is divided into all the technical means which are within the controlled area and the system hardware which are partially or completely outside the controlled area. The structural model of the service information system is shown in figure 3.

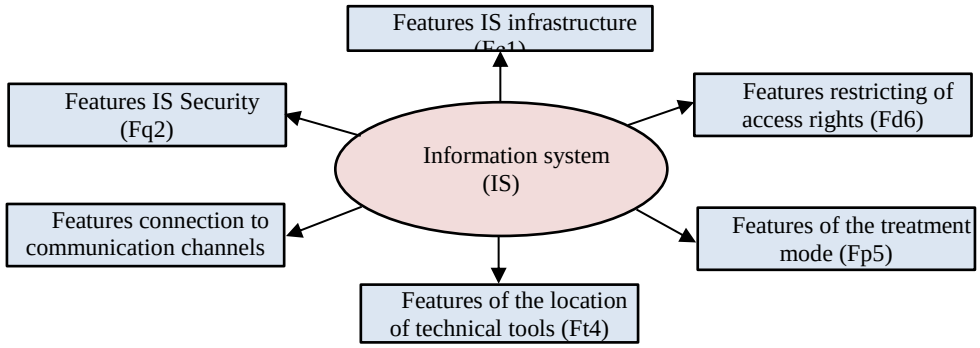

Fig.3. The structural model of the service information security system

Based on the review of the structural model of the service information system, functional model of service information system can be written as:

$$Fuc = f(Fc1, Fq2, Fn3, Ft4, Fp5, Fd6) \quad (1)$$

where: $Fc1, Fq2, Fn3, Ft4, Fp5, Fd6$ −function characteristics of the information system.

In turn, a function of characteristics of information systems can be represented as:

Function of features IS infrastructure

$Fc1 = f(z1, z2, z3)$,

where:

$z1 -$ AW;

$z2 -$ LIS;

$z3 -$ DIS.

Function of features IS security

$Fq2 = f(k1, k2)$,

where:

$k1 -$ typical information system;

$k2 -$special information system.

Function of features connection to communication channels

$Fn3 = f(p1, p2)$,

where:

$p1 -$ connection to the public network;

$p2 -$connection to the Internet network.

Function of features of the location of technical tools

$Ft4 = f(q1, q2)$,

where:

$q1 -$ information system within a controlled area;

$q2 -$ information system partially or totally outside the controlled area.

Function of features of the treatment mode

$Fp5 = f(x1, x2)$

where:

$x1 -$ information processing single-player;

$x2 -$information processing multiplayer.

Function of features restricting of access rights

$Fd6 = f(b1, b2)$,

where:

$b1 -$ processing information without restricting access rights;

$b2 -$ data processing with restricting of access rights.

Given the above and the nature of threats [4] to the structural model of proprietary information security threats can be represented in figure 4.

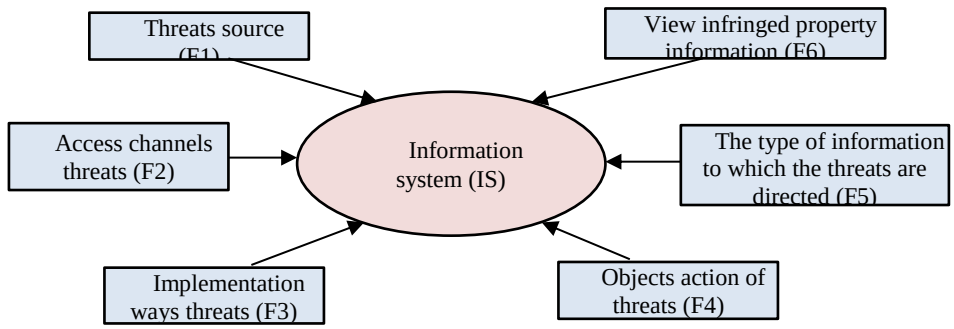

Fig.4. Structural model of security threats the service information in the information system

The functional model of security threats the service information system based on the Fig.4 can be represented as:

$$F_y(t) = f\{((F1(t), F2(t), F3(t), F4(t), F5(t), F6(t))\} \quad (2)$$

where: $F1(t), F2(t), F3(t), F4(t), F5(t), F6(t)$ −function of threat information system.

In its turn:

Function of threats source
$F1(t) = f(a1, a2, a3)$,
where:
$a1$ − threats, posed by the infringer;
$a2$ −threats, posed by hardware bookmarks;
$a3$ −threats posed by software tools.

Function threats through access channels
$F2(t) = f(\beta1, \beta2, \beta3, \beta4, \beta5, \beta6)$,
where:
$\beta1$ − availability of an AS of malware;
$\beta2$ − presence in the AS hardware bookmarks;
$\beta3$ − action when implementing network communication protocols and data channels;
$\beta4$ −lack of technical protection of information;
$\beta5$ −vulnerability of information security tools;
$\beta6$ −vulnerability system in emergency situations.

Function threats for the implementation ways
$F3(t) = f(\gamma1, \gamma2)$,
where:
$\gamma1$ −threats from the special effects;
$\gamma2$ −threats through technical channels.

Function threats through objects action
$F4(t) = f(\upsilon1, \upsilon2, \upsilon3)$,
where:
$\upsilon1$ − threats information in databases;
$\upsilon2$ − threats information as part of the file system;
$\upsilon3$ −threats system software components.

Function threats by type of information
$F5(t) = f(\tau1, \tau2, \tau3, \tau4)$,
where:
$\tau1$ −threats voice information;
$\tau2$ −threats of visual information;
$\tau3$ −threats in the technical tools of processing information;
$\tau4$ −threats information processed in the AS

Function threats by type of infringed property information
$F6(t) = f(\xi1, \xi2, \xi3)$,
where:
$\xi1$ − threats to confidentiality;
$\xi2$ − threats to integrity the software system;
$\xi3$ −threats to availability software to protection of information.

Finally, the functional model of the security service information in the information system can be represented as:

$$F(t) = f\{(Fuc; Fy(t))\} \quad (3)$$

5. Conclusion

The review clearly describes the ways protection the transmission of service information based on monitoring users' workstations in the corporate notification transmission systems. The structural model of service information security in the information system is developed, that allow simulate the perceived threats to the system protection for ensure their neutralization.

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Method Identify for Breaches Information Security in the Network Flows

Komil Tashev, Sherzod Gulomov, Nurbek Nasrullayev

A.Temur street 108, Tashkent, Uzbekistan
k.akhmatovich@gmail.com, sherhisor30@gmail.com, n.bakhtyarovich@gmail.com

Abstract. This article explores the law of the distribution the number of information security message and developed a method for identifying violations and improving the state information security in the network flows. Analysis of the high-level architecture of the monitoring system of information security gives an indication of the fact that at the moment it is not integrated into the means and methods settings of information security tools. The addition of this functionality is appropriate in order to improve usability and unify information security management processes within monitoring system of information security. Also in this paper is proposed implement these improvements through the creation and use of tiered storage of information security message.

Keywords: monitoring system of information security, database, information security tools, operating system, information security policy, detection for breaches information security.

1. Introduction

The collection of information stored in the database (DB) of monitoring system of information security (MSIS), can be used to create a proactive protection by obtaining a consolidated assessment of the monitoring results of information security (IS). Key information used for the consolidated evaluation is the number of messages IS. However, because at different times of the day the number of IS messages can vary considerably, it is necessary to develop a method of detecting violations of IS in the flow of messages IS info communication systems (ICS).

In the process of analysis and data visualization with an increase in the number of message IS significantly increased requirement for performance monitoring system components of IS. As well as it takes time and resources to process structured query to the database. Since modern attacks occur very rapidly, it is necessary to quickly and timely analysis of message IS and take appropriate action. Therefore, the time required to perform structured query, is a serious limitation. As a consequence, the speed of analysis and visualization of communications in the IS data is an area for improvement.

In general, the above analysis of different technical level monitoring elements of IS shows that the level at the current moment is sufficiently formed. However, there may be developed a number of qualitative changes that will complement the ISMS and improve their performance in terms of processing and storage of data IS, common architecture and functionality.

2. The purpose of tasks

Considered methods of analysis number of message IS in the MSIS are classic because they implement methods of analysis of messages IS used in individual information security

tools (IST), but applicable to the DB of monitoring system IS. However, because the DB of MSIS contains messages from all IST organization, it turns out that it is the potential of the MSIS as the organization of the global database remains untapped. There are no methods of analysis, which would give the rating of "health" of the organization in terms of IS and of the security of its business processes, and would consider ISMS as a single database of attacks and worked together with the MSIS other organizations to create a cross-company data bank distributed intrusion prevention.

Since DB of MSIS actually contains information on the status of IS throughout the organization as a whole, it makes sense to carry out additional work on the correlation IS message, such as the analysis to subject, according with agreement about accordance service (AS), the analysis of the requirements of normative documents of the organization and cross-enterprise correlation IS message. Also DB of MSIS can be used to create a proactive protection by producing consolidated, IS evaluation results of the monitoring and implementation of proactive protection based on it.

3. System monitoring of information security

ICS network environment dynamically changes: there are new vulnerabilities, changing the value of the organization's assets, increase the number of known attacks and malicious activity. Hereat MSIS is stored in their data bank large amount of information pertaining to the IS: messages of IS, information about the vulnerabilities of finite systems, information on the implementation of IS policies. The collection of data stored in such a data bank can be used for the formation of a consolidated assessment and decision on the basis of her decision on what protective measures and to what extent are relevant at the current time [1].

Thus, the consolidated estimate is used for monitoring the system operator in the process of ensuring IS (see figure 1).

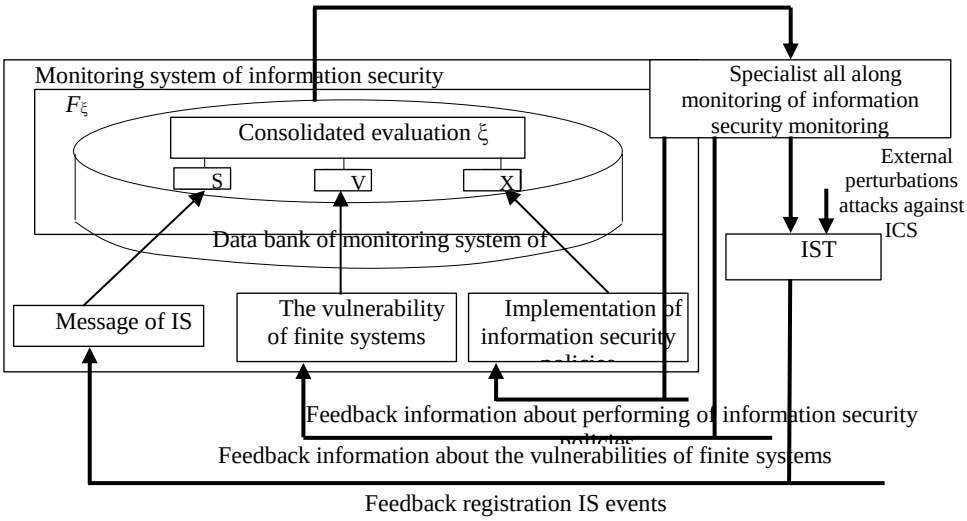

Fig.1. System monitoring of information security ICS

The formal statement of the problem is as follows:

find a function $F_\xi: \{I_X, I_S, I_V\} \overset{F_\xi}{\rightarrow} \xi$, где I_X, I_S, I_V - indicators that measure the amount of the IS

reports, the implementation of IS policies and the vulnerabilities of finite systems, respectively, - consolidated assessment of monitoring IS. As part of this method deals with three types of source information stored in the database of the MSIS, then $n = \overline{1,3}$.

This method considers corporate ICS, is an open environment with access to the Internet. Researches are ongoing for ICS consisting of 10-25 IST and 50-100 hosts. All hosts and IST must be located in the same time zone, the time for all hosts and IST must be synchronized by the selected time source.

Events of IS logging settings for IST should be clearly described in the IS organization and be unchanged for use assessment procedures for the preparation of the consolidated results of the monitoring of IS. Change event logging settings IS involves re-initialization of the methods and techniques developed in the study. Within the framework of the assumption, that the possible response of the system operator does not significantly affect the level of logging events of IS. Possible action by the operator should be clearly described in the IS organization[2].

The present paper is focused on the following IST different manufacturers:

- access controls;
- firewalls;
- network intrusion detection system and intrusion prevention system (NIDS/IDS);
- NIDS/IDS of host level;
- protection against attacks "denial of service";
- means content filtering and protection of Web applications;
- anti-spam;
- anti-virus protection;
- protection from leaks of confidential information.

The IST should support the ability to send recorded IS message of MSIS standard protocols Syslog/HTTPS/SDEE, also to maintain the standard TELNET/SSH/HTTP/HTTPS protocol.

It is considered the following indicators of IS:

- the number IS message - this figure represents the number IS message, fixed monitoring system within the framework of the 10-minute time interval. The indicator is measured by the number equal to the number of recorded IS message.
- implementation of IS policies - this figure reflects the fact how to perform certain position security (PS). For example, if the attack is directed against a domain server, this situation must be distinguished from a situation where the attack is directed against a file server. This indicator allows you to make these distinctions. The indicator is measured by a number from 0 to 100, reflecting the percentage of the security policy;
- the vulnerabilities of finite systems - this figure reflects the fact, as established by relevant patches, updates of operating systems (OS) and the anti-virus database. The indicator is measured by a number from 0 to 100, reflecting the percentage of hosts, the corresponding ideal situation when you have the latest version of the patches, operating system updates, and anti-virus database.

A set of indicators is mandatory for the operation procedures for preparing the consolidated evaluation monitoring of IS. In addition to these measures, organizations can use additional indicators, both technical and non-technical.

It is believed that the above set of indicators is already in the system for monitoring the database and dynamically updated, that is, as the generation of IS messages, they are automatically placed in the monitoring database monitoring system automatically calculates the percentage of the security policy analyst IS promptly adds to the MSIS emergence of new vulnerabilities [3].

This method assumes that the organization has experts with sufficient expertise to assess the values of the indicators and build for them linguistic variables, membership functions and fuzzy rule base.

The insider who may have some knowledge about the internal structure of the ICS, does not allow him to circumvent the IST included in the system of IS are considered as an infringer. In this case the offender does not have the knowledge of the key or password that will allow him to freely gain access to the assets of the organization.

It is necessary to consider the active network attacks that can be identified by analyzing the data contained in the MSIS:

- attacks with the use of network protocols;
- attacks "denial of service";
- password attacks;
- application-layer attacks;
- network reconnaissance;
- unauthorized access attacks using malicious software.

4. Laws researches number of message IS

The main result of any MSIS are a set of reports on the identified events of IS. If ICS is directed against a network attack is the number of IS message is increasing dramatically. This is true both for the known network attacks and zero-day attacks for as IST will register a large number of IS message related to number of IS message network activity[4].

The difficulty is to assess the maximum number of IS message before to conclude that the attack does occur. The allowable number of IS message is determined based on certain defined thresholds. Typically, the threshold values are selected empirically by trial and error so as to achieve a balance between the errors of the first and second kind. The disadvantage of this approach is that the number of IS message received by the MSIS is different during the day and different days of 53 weeks. If the ignore these differences, it is possible to reduce the number of thresholds and their set empirically, but the efficiency of monitoring IS will be very low. If one tries to take into account all the different time slots, it will lead to the fact that the number of threshold values will be very large and their empirically set will be physically impossible. As a result, the job of threshold values empirically or unacceptable is often leads to a large number of errors of the first kind. Only a small fraction of these errors can be subsequently analyzed, which significantly reduces the value of monitoring IS.

It should be noted that there is no single threshold value that can be set in advance to identify the attack and it is necessary to assess the number of IS message, that is to find a function $f_1: i_1 = x_t \overset{f_1}{\rightarrow} l_x$, where $i_1 = x_t -$ the number IS message received on t: time interval t, I_x - indicator for assessing the number of IS message. The solution to this problem requires the creation of adaptive thresholds, which could dynamically learn patterns number IS message and is always up to date as data is updated.

There are several statistical methods set thresholds based on the number of messages on the assessment of incidents in the presence of cyclic data templates. The work was carried out mainly in the field of network technologies and the identification of failures in computer networks. Some researchers propose to split time continuum at intervals short enough to assume that the number of messages on these intervals subject to one distribution law. Next auto regression model is used with a constant. The disadvantage of this approach is that for a quick response time intervals must be very short, since the abnormality detection occurs only in the end of the interval. On the other hand, in the proposed method requires reliable detection of the anomalies of long intervals. Also used a sample size of 10 in the AR model, this statistic is not big enough, so that she could be trusted.

From the point of view of mathematical statistics knowledge of the distribution of the number of IS visitor to a different time of day in the absence of attacks in the ICS will determine accurately the threshold values at the right times. Table 1 shows statistics number IS message for the same 10-minute intervals, collected on a test stand for 8 weeks.

The hypothesis is about absence of attacks in ICS due to the following reasons. Confirm the presence or absence of attacks in real-time is not always possible, since there is a probability of zero-day attacks, 56 which cannot be detected by existing protection. Reliably fact a successful attack can only confirm the subsequent audit of the ICS, after gathering statistics audit of the ICS revealed no successful attacks on the stage of data collection. Moreover, the time interval at which the calculations were conducted number of messages is small, and the statistics collected during the same time interval for 8 weeks.

Thus, the probability that attacks fall during this time interval, each time for 8 weeks is sufficiently small. Therefore it is possible with sufficient certainty that the collection of statistics conducted if no absence, then at least with a minimum of attacks in the ICS (see table 1).

Table 1

The number of IS message within 10-minute interval week

Week/day	1	2	3	4	5	6	7
1	173	154	173	175	162	178	163
2	164	180	172	180	184	180	173
3	164	173	180	174	184	187	184
4	173	184	176	184	192	174	180
5	210	175	175	195	176	185	178
6	185	157	184	185	140	197	185
7	174	180	163	178	184	179	181
8	173	180	175	174	165	173	161
Mathematical expectation (EX): 176.5536				Dispersion (DX): 121.0153			

For the convenience of working with on the basis of the statistics table 1 calculated normalized statistics $\frac{X-EX}{\sqrt{DX}}$, given in table 2. To test the hypothesis that the distribution of the number of IS message in the paper was used nonparametric Kolmogorov. Opting for this criterion is caused by this test is quite simple, it can be used for small samples and it is believed that its higher power than the criterion x^2.

Table 2

Normalized statistics for number of IS message

Week/day	1	2	3	4	5	6	7
1	-0.3230	-2.0502	-0.3230	-0.1412	-1.3230	0.1315	-1.2321
2	-1.1412	0.3133	-0.4139	0.3133	0.6769	0.3133	-0.3230
3	-1.1412	-0.3230	0.3133	-0.2321	0.6769	0.9496	0.6769
4	-0.3230	0.6769	-0.0503	0.6769	1.4041	-0.2321	0.3133
5	3.0404	-0.1412	-0.1412	1.6768	-0.0503	0.7678	0.1315

6	0.7678	-1.7775	0.6769	0.7678	-3.3228	1.8586	0.7678
7	-0.2321	0.3133	-1.2321	0.1315	0.6769	0.2224	0.4042
8	-0.3230	0.3133	-0.1412	-0.2321	-1.0503	-0.3230	-1.4139
Mathematical expectation (EX): 0.0000				Dispersion (DX): 1.0000			

The histogram distribution for the normalized statistics number of IS message is shown in figure 2.

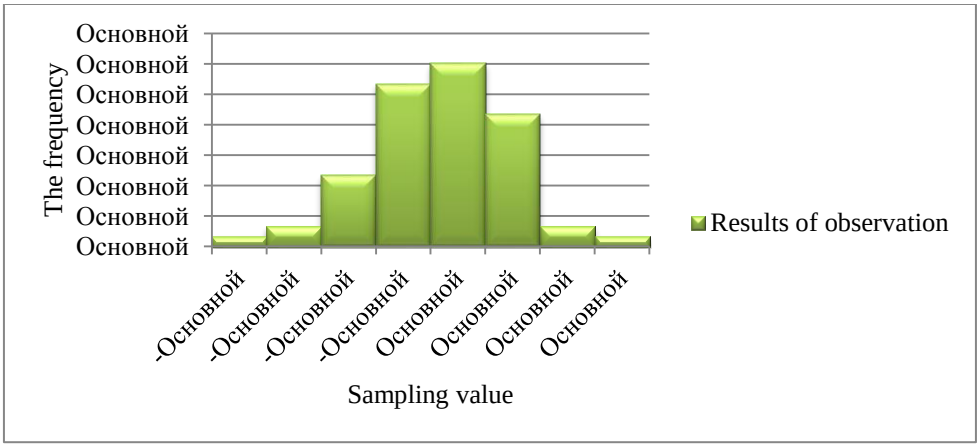

Fig.2. Histogram of distribution number of IS message

The distribution of the sample values is shown in table 3. To construct a histogram of the entire set of sample values was divided into intervals.

Type histogram allows us to the hypothesis that the number of IS message distributed over normal distribution (see table 3).

Table 3
The distribution of sample values

The frequency	Sampling value
0.0167	-2.9251
0.0333	-2.1297
0.1167	-1.3343
0.2667	-0.5389
0.3000	0.2565
0.2167	1.0519
0.0333	1.8473
0.0167	2.6427

To measure the discrepancy between the theoretical values of the normal distribution and the empirical values of the sample is $\lambda = sup_x|F_n(x) - F(x)|\sqrt{n} = 1.2848$, which is less than $\lambda_\alpha \approx 1.36$ for significance level $\alpha = 0.05$. Thus, the hypothesis about the distribution of the number IS message at the normal law is adopted at a given level of significance. Similar

results were obtained for all 10-minute intervals at a significance level is $\alpha = 0.05$.

Under research of laws number IS message important to choose the time interval at which to count the number of IS message. Statistics for various time intervals, collected on a test stand for 8 weeks is given in table 4.

Table 4
Selection of the time interval

The time interval	$\lambda = sup_x\|F_n(x) - F(x)\|\sqrt{n}$	Decision	λ_α	α
20 minutes	0.90	Hypothesis is accepted	1.07	0.2
10 minutes	1.28	Hypothesis is accepted	1.36	0.05
5 minutes	1.54	Hypothesis is rejected	1.36	0.05
3 minutes	1.86	Hypothesis is rejected	1.36	0.05
1 minute	2.54	Hypothesis is rejected	1.36	0.05

5. Conclusion Introduction

As a conclusion, it should be noted if it (see below results of tables) selects a very large range, the law of distribution of message will be more pronounced, but it will reduce the response time to changes in the network environment. On the other hand, if it selects a very small interval, the law of distribution IS message will be difficult to determine. In method were presented the number of IS message for the following time intervals: 20 min, 10 min, 5 min, 3 min, 1 min. 10-minute interval of time has been selected on the basis of the researched statistics, since on the one hand the law of distribution IS message at this time slot is pronounced, on the other hand it provides an adequate response time to changes in the network.

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Construction of Detection and Prevention Network Attacks on the Cloud Computing System

Salim Ganiyev, Madjit Karimov, Odil Zokirov

A.Temur street 108, Tashkent, Uzbekistan
sherhisor@mail.ru , dr.mmkarimov@rambler.ru , z.odil044@gmail.com

Abstract. The paper describes the problems and vulnerabilities of cloud computing systems and presents approach for the establishment of the experimental sample of intellectual protection against attacks. For improving the recognition rate was proposed algorithm separation of network traffic on the basis finite automat. The modules of intellectual protection cloud system are analyzed.

Keywords: DoS-attack, cloud system, network sensors, network adapter, component management module, recognition rate.

1. Introduction

The rapid development of distributed IT-systems is accompanied by a growing number of network attacks, directed against both the separate computer systems and computer networks in general. Countries with the most advanced in the field of distributed computing policy, such as Japan, Germany and the United States, engaged in the creation of the fundamental legal framework that allows to support the growth of cloud computing. Primarily is made to establish standards in concepts and structures. There is no clear description of the standard construction of such systems at the moment does not exist, and already having distributed systems security issues. The protection of such systems is still open to the leading players in the IT-market.

Cloud computing is an innovative technology that provides dynamically scalable computing resources and applications through the Internet services under the control of the service provider to pay for the actual services received and resources. Cloud computing is becoming increasingly popular, especially in recent times, when limited financial resources has forced companies to optimize costs: no need to spend huge amounts of money to create their own data centers to pay for licensed software, the maintenance of qualified personnel. You can simply automate all IT processes, purchasing ready-made packages SaaS, DaaS, IaaS or PaaS. However, there are some doubts about the security of these solutions, in particular, issues of security against network attacks. In this regard, the leading software development companies have directed their efforts at creating tools protection of cloud computing environments.

2. Problems and vulnerabilities of cloud computing systems

The rapid development of the cloud has caused a lot of new challenges, among which are the following:

Loss of customers. Due to the large influx of users of services that use cloud computing, increasing the likelihood of losing customers because of leaks from such resources.

Affected software cloud elements. The threat is realized by hackers through the use of

vulnerabilities in operating systems, network services, etc. For example, database servers can be attacked by SQL-injection. Successful implementation the attacks give an attacker access to the system data or disrupt its functionality.

The vulnerability of the network cloud infrastructure. This type of vulnerability is associated with distributed cloud architecture and the general principle of security, according to which the system of protection is determined by the security of its weakest link [1]. Successful DoS-attack on one of the network components may block access to the whole system despite the fact that other connections between components of the system are not violated.

Availability of attacks on virtualization system. To combine and coordinate the various cloud components are used virtual environments, so the attack on the virtualization system, coming from the user tasks that run in the cloud, cloud threaten the whole as a whole. This type of threat is specific to cloud computing systems.

Complex systems of cloud computing threats. Provide security in process control the work of all the cloud nodes and manage them, as well as is a thin spot in the protection of cloud computing systems. The intruder can put their order to use the cloud to solve their problems and distort the evaluation of cloud resources, virtual machine management, and system configuration. This type of threat is also specific to the cloud and is connected with the possibility of abuse, which may lead to that the computational power of the cloud and its resources will work for the intruder.

These problems are mainly associated with the complex architecture of the protected system. Unlike a personal computer protection, where the object is an individual device with a specific architecture, in this case, the object is a set of computing nodes connected in a multi-level network segments that can be joined through the Internet. As a result, an attacker opens a lot more goals and opportunities for attack. Thus there is a danger not only to access data, but also raises the question of integrity violations and efficiency of computer systems. For a detailed study of the above problems and find their solutions is carried out to develop a comprehensive protection of distributed computing systems based on artificial intellect methods and probability theory:

1. The network analyzer to detect attacks;
2. The protection mechanism of interaction in the cloud architecture;
3. Protection of the system management tools.

3. Protection system architecture

Architecture experimental sample of intelligent cloud security system is shown in figure 1.

Copies of the system are placed in all the nodes of the distributed configuration and analyze traffic, interacting with each other. The protection system is divided into several modules performing tasks: network traffic analysis, decision correlation reaction, storage, control components.

Analysis module is based on a network of software sensors. Each fieldbus protected object is set for one sensor. They secrete informative signs describing the state of the protected system and data packets circulating on a particular network. Helpful features can be divided into six groups:

– allocated from the header of network packet;

– allocated from the informational part of the packet on the basis of expertise or as information about the state of the controlled unit;

– attributes, whose values are calculated as the statistics for the last two seconds of network activity for TCP-protocol;

– attributes, whose values are calculated as the statistics for the last 100;
– allocated on the based HTTP request-analysis;
– attributes, whose values are calculated as the statistics for the last two seconds of network activity for SNMP-protocol.

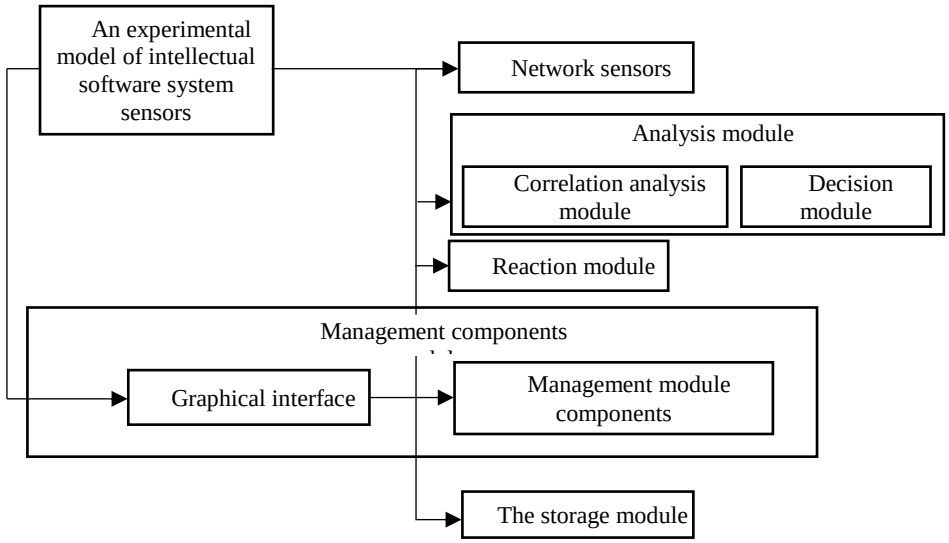

Fig.1. Architecture experimental sample of intellectual protection cloud system

The first four groups of informative attributes detected by the ready algorithm of analysis various network attacks that located in the public domain [2]. This set of attributes describes the basic parameters of the network exchange.

The second group of attributes intended to identify certain types of HTTP-exploit-s.

The last group is responsible for checking violations of the SNMP-protocol standard.

To identify abnormal network activity in the decision module mechanism is used a two-level classification of network records (see figure 2).

In earlier researches were worked issues of intellectual processing of network traffic by using neural networks. Successfully tested and achieved high indicators of quality were conducted recognition of typical network attacks. The main disadvantage of neural networks is the low recognition rate. To improve the recognition rate was proposed algorithm rapid separation of network traffic on the "safe" and "suspicious". This algorithm is based on the use of finite automat, which is constructed with using genetic trained algorithms. These developments provided the basis for creating classifying of system module.

In the first level there is a classifier based on the finite automat that separates network recording into two classes: the "norm" and "suspicion of the attack".

The second level is a classifiers committee:

– classifier based on support vector;
– neural network classifier based on multilayer neural network of direct distribution, trained by method Levenberg-Marquardt;
– classifier based on the distance Euclidean-Mahalanobis.

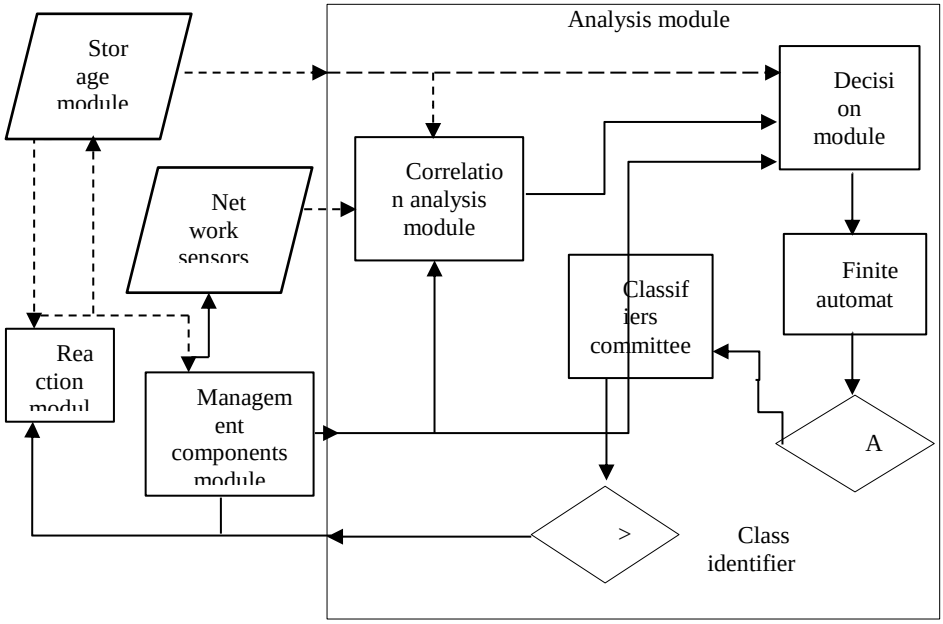

Fig.2. Network processing mechanism records

Each classifier is trained to recognize not only the classes of attacks, but the "norm". The need for recognition of the "norm" arises from the inadmissibility of false positives defense mechanisms. The committee in this case - is a set of qualifiers, which takes the total solution based on counting the number of votes of each of the classifications submitted for one or another type of network activity. If the number of votes for the "norm" coincides with the number of votes for any attack class, the network entry refers to "normal".

If the number of votes is the same for different classes of attacks, the network record belongs to a class of unknown/mixed attacks. Use the automatic models with a pair of dedicated able to reliably solve the problem of determining the fact of the attack, and the use of the two-level classification - significantly increase the speed of processing network traffic under normal conditions.

A distinctive feature of the use of neural network classifiers and genetically generated machine is the principle of their formation. They all require the implementation phase of training. The proposed approach has positive and negative sides. The negative features include a long time training the classifier to work. For learning a prepared sample is required, and the quality of recognition depends on its composition [3-4]. The greater the variability of the attacks in the sample, the greater the accuracy of the classification can provide the committee. However, unlike signature-based approach, which requires the presence of an expert to determine the attack signature, this method involves the automatic selection of informative features from the training set. A selection of the training sample can perform a user who does not have expertise.

Correlation module based on the methods of probability theory produces a ranking of network attributes in importance, and assesses the results obtained from the decision-making modules of different cloud nodes. Ranking results change the order of the input feature set for the machine. These actions are associated with different levels of importance of signs for a variety of network attacks, which greatly speeds up the process of recognition of the fact of

attack on the ground level traffic classification. Reaction module disables the node to different types of attacks, blocks the transmission and gives a warning message via the graphical interface.

The main task of the storage module is to provide the information necessary to ensure the protection of the system performance [5]. Such information, for example, includes the modules and setting qualifiers. The module provides mechanisms to maintain a network of traffic signs and, in connection with the orientation on a distributed architecture that organizes the synchronization settings, and the knowledge base system instances on different nodes. An important function of the module is event logging.

Component management module provides (see figure 3):

- local interaction modules; interaction of relays are located on different nodes;
- synchronization protection system;
- graphical interface for the administrator to manage and display information.

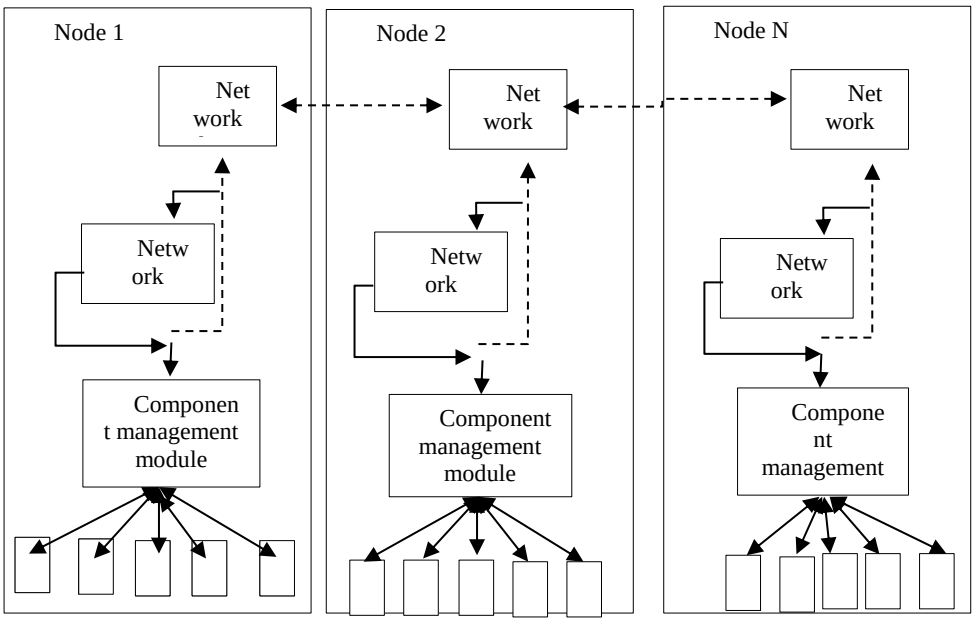

Fig.3. Component management module

It initializes the modules, transfer settings, as well as monitoring the integrity of the system, reporting faults at the initialization stage. The main feature of the module is to enable centralized management of security system. At the same time synchronization and support for multiple points "input" is necessary to exit the case of the cloud system components fail. The failure of one component does not affect the functionality of the cloud as a whole, should not affect the performance of the protection system.

4. Conclusion

The review clearly shows the problems and vulnerabilities of cloud computing systems. Under analysis vulnerabilities was proposed the algorithm separation of network traffic. Overall, the constructed protect information system through the use of neural network classifier provides recognition the modified network attacks and detect patterns and anomalies in data flows in cloud computing systems.

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Method of Conformity Assessment Learning Outcome to Professional Competences

Madina Bazarova, Gulnaz Zhomartkyzy

D. Serikbayev East Kazakhstan State Technical University, Ust-Kamenogorsk, Kazakhstan
madina_vkgtu@mail.ru, gomartova@mail.ru

Abstract. The article describes the modular-competence approach in the formation mechanism of reference learning outcomes of educational program for professional competency. The developed ontological model based on the modular-competence approach to assess compliance with the requirements of the learning outcomes of labor functions used an approach based on method of hierarchy analysis. The method of hierarchy analysis allows reconciling the theoretical generalized results of educational programs with professional requirements of employers. The method of hierarchy analysis tested for the position «Information Security Specialist». Students can build a personalized learning trajectory aimed at obtaining concrete results, using this approach

Keywords. Modular-competence approach, professional competence, ontology, educational programs.

1. Introduction

The aim of the study is to construct an ontological model of educational programs and professional competencies. Compliance with the learning outcomes of educational program professional requirements will allow the university to respond flexibly to changing environmental conditions and to develop educational programs, improving the quality and relevance of the education market.

Modular-competence approach using ontology to educational programs reflected enough in the works [1 - 5]. At the same time, account of labor market needs is reflected in the development of educational programs insufficiently. This paper presents the results of compliance training curriculum professional requirements.

2. The ontological model of professional competences of the educational program

Appointment of the ontological model of professional competence of the educational program is to display the content of a professional standard labor functions for a specific type of activity and the specific level of qualification to academic competence, thereby increasing the quality of the content of educational programs and providing graduate ready for professional work in a particular position. In the Republic of Kazakhstan are at the stage of development of professional standards, on which universities to develop educational programs for specialist training [6].

Developed ontology of educational programs and professional competencies, which allow you to check the axioms output modular structure of the educational program and the consistency of its components, data from the professional standards [7]. Figure 1 shows a fragment of the ontology. An ontology together with a plurality of individual instances of classes make up the knowledge base.

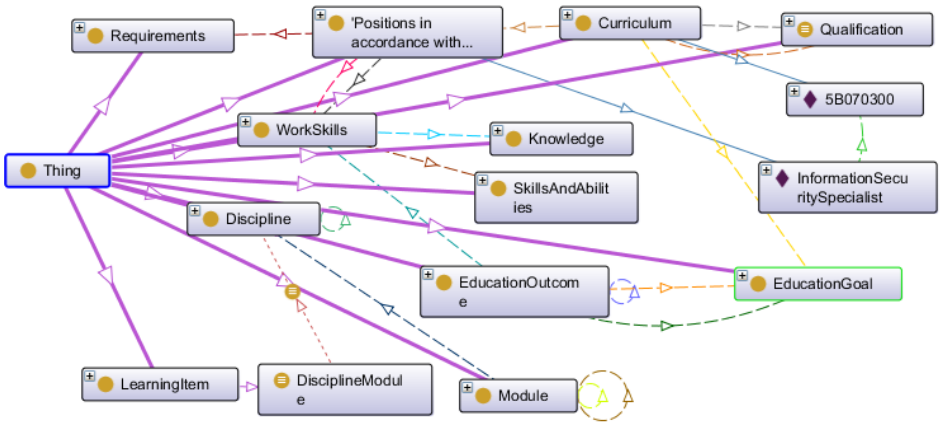

Fig. 1. The deduced ontology of educational programs and professional competencies

The main classes are developed ontology: Curriculum, Module, Discipline, Education Outcome, Learning Item, Qualification, Work Skills, Position in accordance with Professional Standard, - Requirements, Skills and abilities, Knowledge.

As an example, to display the properties of the selected ontology curriculum 5B070300 – «Information systems» and the position «Information Security Specialist» of the Republic of Kazakhstan Project Professional Standards [8] (Figure 2).

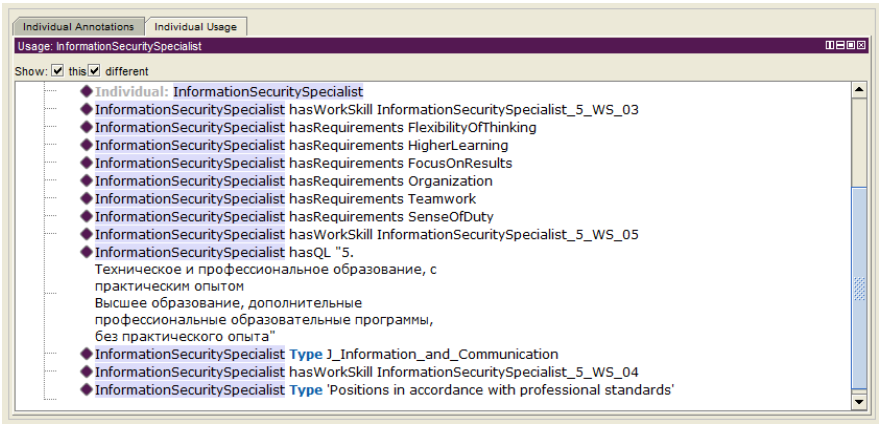

Fig. 2. Description of the individual

Description in the individual «Information Security Specialist» Protégé 4.3 is shown in Figure 2. It reflects data on object properties and the properties of the data type of the individual and their meanings.

3. Testing of method of hierarchy analysis

To assess the importance of articulated learning outcomes and professional competencies of the requirement to use method of hierarchy analysis. Method of hierarchy analysis to rank the usefulness of learning outcomes (competences) from the position of labor functions.

Method of hierarchy analysis involves decomposition problems on everything simpler

component parts and processing expert judgments. The result is determined by the relative importance of the investigated options for all hierarchy criteria [8, 9].

To test the action of method of hierarchy analysis was developed by the hierarchy of the elements of a modular educational program on specialty «5B070300 - Information Systems» and position «Information Security Specialist» of the project the professional standard of the Republic of Kazakhstan [7]. From modular educational program were taken goals, learning outcomes and modules that provide these learning outcomes.

Learning outcomes:

- L 1 have a basic knowledge in the field of natural sciences (social, humanitarian, economic) disciplines that contribute to the formation of a highly educated person with a broad outlook and a culture of thinking
- L 2 speak a foreign language at a level that allows you to work in an international environment with an understanding of the cultural, linguistic and socio - economic differences;
- L 3.1 know the basics: computer science as a science, industry and infrastructure sectors; algorithms and data structures; theory of information systems;
- L 3.2 know the methodological basis of modern information technologies used in process engineering / re-engineering of information systems and databases;
- L 3.3 Know the model descriptions and information processes and systems modeling technology;
- L 4 be able to assess the reliability and security of information systems;
- L 5 have the skills to design information systems for various applications and their components in accordance with industry and international standards;
- L 6 to know the methods of analysis and evaluation of the effectiveness of the design and operation of information systems;
- L 7 to be able to perform the installation, configuration, and debugging components of information systems, configure and administer network infrastructure systems;
- L 8 have the skills to select the architecture and aggregation of hardware of information systems;
- L 9 have an understanding of IT project management methods, organization and budgeting of individual stages of the process of development and maintenance of corporate information systems;
- L 10 to be able to organize the placement of computer equipment, to equip workstations users of information systems;
- L11 have the skills assessment of production and non-production costs of the functioning of the corporate information systems;
- L12 to be able to use mathematical methods of processing, analysis and synthesis of professional studies;
- L 13 to be able to carry out a systematic collection of scientific and technical information, the analysis of domestic and international experience on the subject of research on the Internet, scientific and periodical literature;
- L 14 to know the basics of innovation management and strategic planning;
- L15 to be able to identify the direction of development of the IT infrastructure of enterprises and organizations.

The labor function for the position of «Information Security Specialist»:

1) Planning management processes Information Security Organization (LF1).
2) Planning processes to ensure information security organization (LF2).
3) Planning to ensure information security organization (LF3).
4) Control of management processes and ensure information security organization (LF4).
5) Ensuring information security organization (LF5).

To assess the compliance of learning outcomes (competences) qualification requirements for a specific labor functions position, need complete a few steps.

Step 1. A hierarchical view of problem.

Construction hierarchy begins with a delineation study of the problem. Next, build their own hierarchy, including the purpose, located at its top, intermediate levels (for example, the criteria) and variants, forming the lowest hierarchical level [8]. The variants used the learning outcomes of the curriculum. Intermediate levels are: labor functions for a particular position and goals. Figure 3 shows this hierarchy.

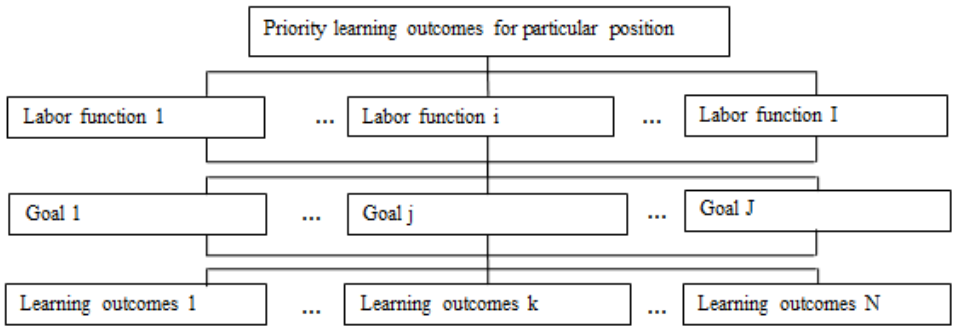

Fig. 3. Hierarchy of criteria for determining the priority of learning outcomes

Step 2. Building a matrix of pairwise comparisons.

When constructing the set of paired comparisons matrices in the hierarchy stand the elements of two types: «elements - the parents» and «elements – descendants». The following matrix are being constructed of pairwise comparisons, based on the hierarchy of relations:

- labor functions in relation to the post;
- goal of in relation to each job description;
- learning outcomes in relation to each goal.

Step3. Filling the matrices of paired comparisons involved experts.

Pairwise comparisons are made in terms of the dominance of one element over another. For example, "Rate the importance of learning outcomes 1 and learning outcomes 2 in relation to the objective 1". These judgments are expressed in whole numbers from nine-scale relations [8].

Step 4. Calculations

After filling the experts paired comparisons matrix, perform calculations.

Implemented hierarchical synthesis in order to determine the priority vector of options regarding the factors and focus hierarchy [8, 9].

To determine the priority vectors of options necessary to find the values of the vectors of priorities - the priorities of the labor vector functions for position vector with respect to objectives and priorities of each labor function, the vector priorities of learning outcomes with respect to each target. From the resulting vector priorities are determined using these vectors priorities.

An analysis of the values obtained by the resultant vector shows what options (learning outcomes) priority for the position.

Spend a peer review procedure with the participation of leading IT professionals as a result of which the vector priorities of learning outcomes (competences) and built a diagram

was designed. Results of evaluation of the importance of competencies of graduates formed for implementation of identified labor functions shows the diagram of Figure 4.

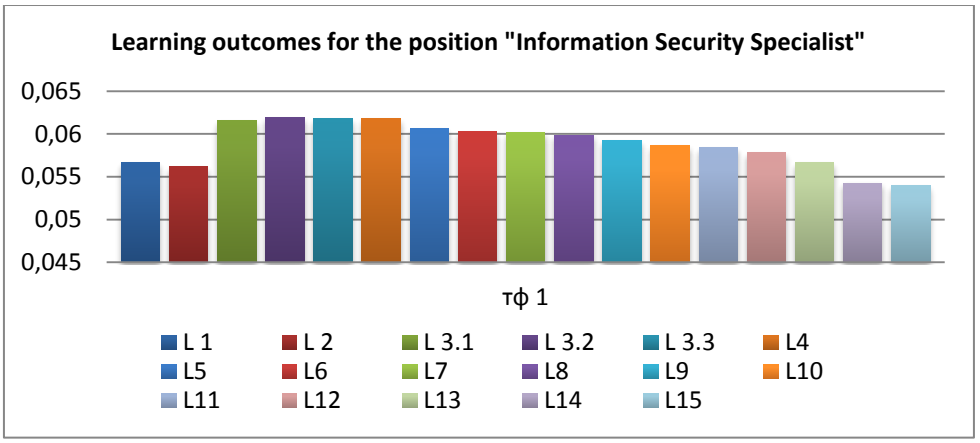

Fig. 4. Learning outcomes

Figure 4 reflects the priority learning outcomes (competence) of the educational program for the position «Information Security Specialist»:

- L 3.2 know the methodological basis of modern information technologies used in process engineering / re-engineering of information systems and databases;
- L 3.3 Know the model descriptions and information processes and systems modeling technology;
- L 4 be able to assess the reliability and security of information systems;
- L 3.1 know the basics: computer science as a science, industry and infrastructure sectors; algorithms and data structures; theory of information systems.

The learning outcomes have lowest priority:

- L15 to be able to identify the direction of development of the IT infrastructure of enterprises and organizations;
- L 14 to know the basics of innovation management and strategic planning.

4. Conclusion

Built ontological model of educational programs and professional competencies to needs labor market, based on the Republic of Kazakhstan professional standards projects. Method of hierarchy analysis tested for the position «Information Security Specialist».

The knowledge base of educational programs and professional competencies allow students to build individual learning trajectory aimed at obtaining specific results needed to perform his labor functions of interest.

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Structural Interrelations Modeling in Hierarchical System of Competitiveness Management on Organizational and Managerial Principles

Olena Sergienko[1], Maryna Tatar[2], Olga Gaponenko[3]

[1] State Higher Educational Institution, University of Banking, Kharkiv, Ukraine
ser_helenka@ukr.net
[2] Zhukovsky National Aerospace University «KhAI», Kharkiv, Ukraine
marina.tatar@yandex.ua
[3] National Technical University «Kharkiv Polytechnic Institute» Kharkiv, Ukraine
gaponenko_oe@mail.ru

Abstract: The complex of models for improving of engineering enterprises competitiveness management hierarchical system on the bases of organizational and management principles is presented in the form of interrelated mechanisms and models, methodological and instrumental tools. The paper proposes three aggregated modules of system of scenario competitiveness management such as complex diagnostic of competitiveness level and organizational and management potential; assessment and analysis of internal and external environment threats; implementation of scenarios of situations development in terms of threats. The models of organizational and management potential influence on general integral competitiveness index are built on the basis of simulation scenario approach. The proposed complex of models of scenario management makes possible to develop the most effective strategy of enterprises competitiveness management on the bases of verified knowledge of the investigated situation because it explains the factor or several factors we should impact and force and direction of this influence.

Keywords: competitive stability, integral index of competitiveness, organizational and management potential, scenario modeling, simulation

1. Introduction

Effective functioning of Ukraine economy in conditions of global transformation processes is not possible without sustainable development of its productive potential. Poor management market processes at all levels of the hierarchy provoke the crises and lead to economy destabilization. The national economy restructuring, transformation processes that occur in it, actualize the competitiveness management of enterprises production and economic processes (PEP). The implementation of appropriate strategic alternatives of industrial enterprises will contribute to significant improvements in the development of innovative models of industrial development and economy of Ukraine as a whole in the context of competitiveness.

The rapid external environment changing and their weak predictability, competition in the national market increasing through Ukraine integration processes and globalization trends strengthening determine the feasibility of permanent improvement of internal environment and the appropriate tools using for these reforms implementing. This is the basis of significant interest in improving the competitiveness management of PEP and the determination of strategic priorities of in non-linear dissipative environment adapted to each enterprise.

The complex of economic and mathematical models of PEP competitive development on the bases of evaluation and analysis of their potential on organizational and management principles in terms of threats of internal and external environment is actual now.

2. Analysis of the recent research and problem definition

The current practice of competitive management indicates that the companies to strengthen its competitive position in the market and enhance its competitiveness have to resort to some innovative changes. Despite significant research of innovation management in the papers of such scholars such H. Barnett, V. Geyets, B. Ginzburg, V. Hartman, M. Kondratiev, B. Santo, R. Solow, E. Toffler, M. Tugan-Baranowski and other the problem of creating of preconditions for effective implementation of innovations in Ukraine enterprises, especially management, will always remain relevant in conditions of severe competition.

A variety of operating conditions of PEP, distinction of their degree of involvement in the innovation process, different stages of the life cycle of innovations of each company or industry need to create appropriate management support of innovative processes development adapted to industry needs which ensures competitive position strengthening and the strategic platform of enterprises development strengthening. The system of enterprises competitiveness is dynamic and requires constant management innovation in quick environment conditions and its improvement involves aggregation and composition of all possible factors, which are the backbone in this complex hierarchical system. One of the main factors of competitiveness is available organizational and management potential, as its impact on the various components of competitiveness is crucial.

In this paper the authors proposed the concept of building of complex models of enterprises competitiveness scenario management which provides solution of such problems: factorial trends research, external and internal environment research, realization of models of competitiveness complex diagnostics and organizational and management potential and dynamics of their development for comparative spatial analysis, models of long-term interaction to analyze temporal changes the dynamics of each company and assessing threats for competitiveness and potential as well as competitiveness management on the bases of scenario approach in formation and implementation of development strategies to prevent crises in terms of threats.

3. Research results

Consider the complex of models of hierarchical system of competitiveness scenario management on organizational and management basis for formation of adequate information and analytical base of management decisions. The scenario management of enterprises competitiveness under the influence of external and internal factors is management aimed at neutralizing the predicted storms and obstacles that for a specific time and at minimal cost makes possible to create and implement the adjusted development strategy within previously defined strategic objectives of the company, the existing organizational and management potential and appropriate resources on the bases of the principles of continuity of management process; organic combination of enterprise competitiveness management processes into a single integrated complex in hierarchical system. Thus, the system of competitiveness scenario management can be represented as a set of interrelated mechanisms by which we mean a way to use a certain set of methodology, instrumental and information tools for solving problems. Three main aggregated modules of hierarchical system competitiveness scenario management with organizational and management positions are presented in Fig. 1.

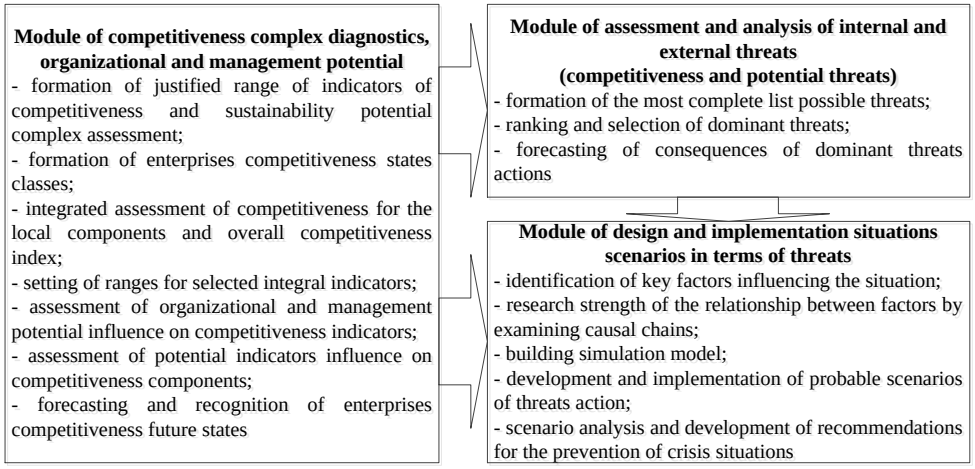

Fig.1. Scheme of relationship between modules of enterprises competitiveness scenario management on organizational and management principles

Complex of methods and models underlying the development of enterprises competitiveness scenario management is founded on such economic and mathematical tools:

- expert, factor, parametric and nonparametric methods for forming a system of indicators to measure and analyze the organizational and management potential level, competitiveness and internal and external threats;

- integral methods for assessment of competitiveness components and overall competitiveness level;

- cluster analysis for creation of competitiveness classes and the organizational and management potential level;

- methods of variance analysis for determination the influence of organizational and management potential on the competitiveness components by different groups and states;

- discriminant analysis models for identification and prediction the competitiveness and potential level;

- panel data models for determination the direction and force of influence of organizational and management potential indicators on the competitiveness components;

- methodology of simulation modeling for predicting the competitiveness level in terms of stability threats;

- methodology of decision-making for generating scenarios of situations development.

The critical analysis of the literature [1 and others] indicates the existence of diversity in the competitiveness evaluation approaches so the following indicators characterizing the organizational and management potential and enterprises competitiveness taking into account machine-building industry characteristics are proposed (Tab. 1).

The analytical assessment of the organizational and management potential and competitiveness of machine-building enterprises on the bases of cluster analysis methodology is proposed. The tasks of cluster analysis are analyzing the details of the organizational and management potential and competitiveness by identifying of homogeneous groups of machine-building enterprises and reduction of the dimensionality of data quality by three levels: high, average, low.

Table 1 - Indicators of organizational and management potential and competitiveness of machine-building enterprises

Indicator	Directions of positive change
Organisational and management potential	
Compliance hierarchy ratio *(x1_p)*	Orientation to 1
Ratio of autonomy management organizational structure *(x2_p)*	Increase
Ratio of management structure decentralization *(x3_p)*	Increase
Ratio of management efficiency *(x4_p)*	Increase
Production competitiveness	
Production material capacity *(x1_vk)*	Decrease
Ratio of technical suitability of fixed assets *(x2_vk)*	Increase
Assortment rate of changes *(x3_vk)*	Increase
Financial competitiveness	
Ratio of financial autonomy *(x1_fk)*	>0,5
Overall liquidity ratio *(x2_fk)*	1,5–2,5
Profitability of products *(x3_fk)*	Increase
Stability index of economic growth *(x4_fk)*	>0,2
Marketing competitiveness	
Return on sales *(x1_mk)*	>0,2
Ratio of market research costs to total sales *(x2_mk)*	Decrease
Social competitiveness	
Ratio of the average wage to the industry average *(x1_sk)*	Increase
Proportion of workers retrained and training *(x2_sk)*	Increase
Staff stability coefficient *(x3_sk)*	Increase

The comparison of levels of organizational and management potential and competitiveness of each machine-building enterprises using the classification results, namely share certain level (high, medium, low) in total is presented in Fig. 2. The machine-building enterprises in 2012-2015 years had the largest share of marketing stability high level (61%) that was accompanied by relatively high production stability (45%) and average financial stability (58%). However, there was significant part of enterprises with low production and social competitiveness (33%), which indicates underutilization of production potential.

The general integral index and local competitiveness indicators [2] in such areas as production, financial, marketing and social in 2012-2015 years are calculated by taxonomy and rating evaluation [4].

The general integral index of enterprise competitiveness (I_{gc}) is:

$$I_{gc} = \sqrt[4]{I_{pc} \cdot I_{fc} \cdot I_{mc} \cdot I_{sc}}, \quad (1)$$

where I_{pc} – production competitiveness; I_{fc} – financial competitiveness; I_{mc} – marketing competitiveness; I_{sc} – social competitiveness.

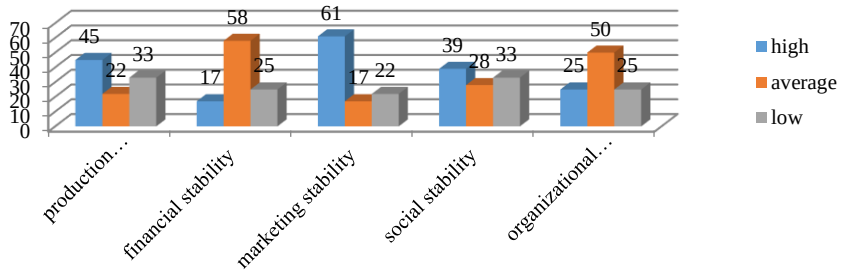

Fig. 2. Distribution of organizational and management potential and enterprises competitiveness levels (2012-2015 years)

The comparative dynamics of general indicators of machine-building enterprises are presented in Tab. 2.

Table 2 - Dynamics of enterprises competitiveness integral index (fragment)

Enterprise	Year			
	2012	2013	2014	2015
Azovmash	0,44	0,43	0,50	0,48
Kharkiv machine-building plant "Light Miner"	0,84	0,62	0,48	0,49
…	…	….	…	…
Gorlivskiy mashinobudivnyk	0,75	0,60	0,42	0,70

The steady growth of the general competitiveness level in 2012 – 2015 years was observed in any of the investigated enterprises. Almost all enterprises (except enterprise "Azovmash") have unstable dynamics of the integral index. The distribution of observations for the investigated enterprises by the integral index of competitiveness level is presented in Tab. 3.

Table 3 - Distribution of enterprises by the integral index of competitiveness level

Condition type	Value of the integral index	% of enterprises
nearly absolute stability	[0,7-0,85]	11
significant stability	[0,55-0,7]	14
normal stability	[0,4-0,55]	33
unstable state	[0,25-0,4]	22
crisis state	[0,1-0,25]	20

The values of integral index demonstrate that the largest share has enterprises with normal stability (33%) and the least share has enterprises with nearly absolute stability (only 11%).

The aggregated results on the bases of realization of methodology of variance analysis and values of determination coefficient which characterizes the influence of organizational and management potential on the competitiveness indicators are presented in Fig. 3.

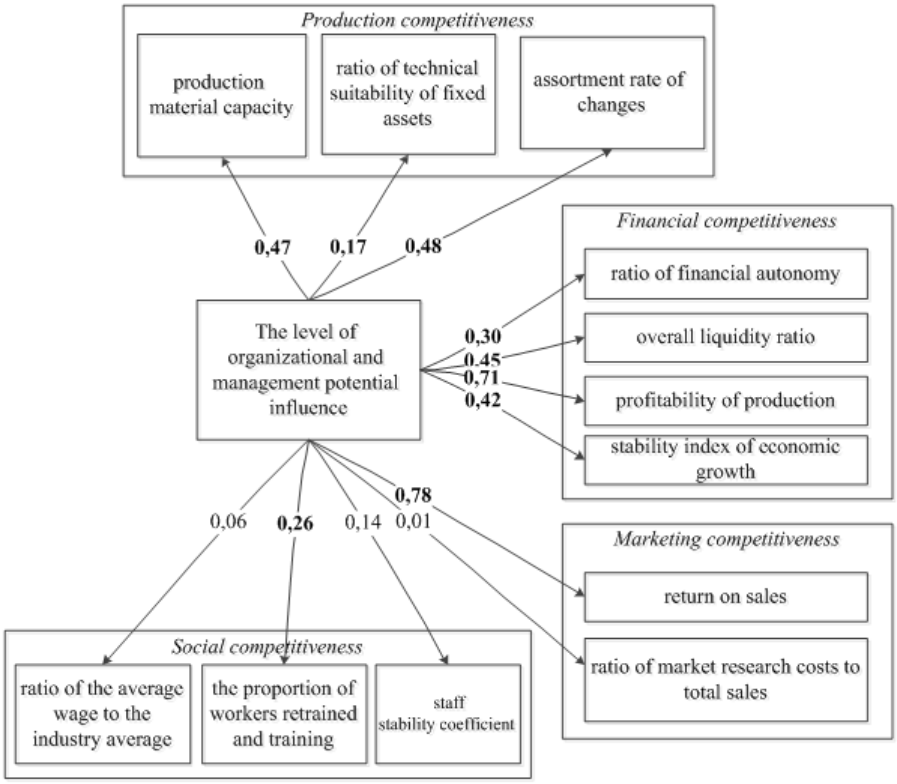

Fig. 3. The results of the evaluation of the influence of organizational and management potential on the machine-building enterprises competitiveness indicators

The panel data econometric models with fixed effects and lagged component for the studied components of competitiveness are:

$$I_{pc} = 3{,}37\ x_{2p(t-1)} + 0{,}41\ x_{3p(t)} \quad (R=0{,}99)$$

$$I_{fc} = -1{,}51\ x_{2p(t)} + 0{,}03\ x_{4p(t-1)} \quad (R=0{,}97)$$

$$I_{mc} = -0{,}13\ x_{1p(t)} + 1{,}24\ x_{2p(t)} - 0{,}02\ x_{3p(t)} \quad (R=0{,}99)$$

$$I_{sc} = 0{,}32 x_{1p(t)} - 0{,}006\ x_{4p(t-1)} \quad (R=0{,}99)$$

The choice of the dominant factors for each selected class of the organizational and management potential and competitiveness of enterprises was done on the bases of the analytic hierarchy method. Significance of the factors was determined on the bases of vector of priorities. Destabilizing factors which affect the organizational and management potential of industrial enterprises are given in Tab. 4.

Table 4 - Factors which affect the organizational and management potential of industrial enterprises

Indicator (Name and designation)	Destabilizing factors (Name and designation)
Compliance hierarchy ratio (x1_p)	ux_{11} – the nature of activity, variety of problems and methods of their solving; ux_{12} – knowledge management, training of employees, and their interest in the outcome; ux_{13} – presence of unexpected and uncertain situations; ux_{14} – degree of standardization procedures, lack of technical equipment of management activity; ux_{15} – reliability of communications activity and specificity of tasks; ux_{16} – level of organizational culture and the culture of interpersonal relations; ux_{17} – territorial dispersion of performers; ux_{18} – value of management authority
Ratio of autonomy management organizational structure (x2_p)	ux_{21} – blurring of functions and duplication of responsibilities and powers of employees of different departments; ux_{22} – personification of the responsibility for the organization and execution of each function unit
Ratio of management structure decentralization (x3_p)	ux_{31} – changes and uncertainty of the external environment; ux_{32} – crisis state of the national economy; ux_{33} – level of importance of the decisions made at lower levels of management; ux_{34} – consequences of the decisions made at lower levels of management
Ratio of management efficiency (x4_p)	ux_{41} – timely preparation and decision making; ux_{42} – reaching target plans level; ux_{43} – presence of deviations in the implementation of tasks; ux_{44} – violation of regulations of management personnel; ux_{45} – stability management structure level; ux_{46} – turnover rate of management.

Thus, the totality of the selected factors and threats are the basis for building simulation model. The additional variables *UX1, UX2, UX3* and *UX4* which reflect the cumulative effect of threats to potential components *x1_r, x2_r, x3_r* and *x4_r* were put for modeling of the influence of destabilizing factors (threats). The influence of each *i*-th factor on the *j*-th component of the organizational and management potential is described by quality scale:

$ux_{ij} = -1$, if destabilizing impact of factor (threat) is negative (factor contributes to the development of organizational and managerial potential component);

$ux_{ij} = 0$, if the factor impact is absent;

$ux_{ij} = 1$, if destabilizing impact of factor (threat) is positive (factor threatens the development of organizational and management potential component).

So under the influence of a set of destabilizing factors (threats) the organizational and management potential component will change as follows:

$$x_i\_p1 = x_i\_p \cdot \left(1 - \frac{UX_i}{10}\right)$$

That is, we protrude assumption that the cumulative effect of destabilizing factors lead to varying of enterprise organizational and managerial potential within 10% on the bases of

the values of integral index of the general competitiveness level. The modeling of the influence of organizational and management potential on the general integral index of competitiveness is realized on the basis of simulation scenario approach for taking account of systematic interrelated factors of organizational and management potential on marketing, financial, social components of competitiveness, which makes possible to assess the quantitative and predictive value of the general level of development. The block of simulation model of the influence of organizational and management potential on the total integral competitiveness index is presented in Fig. 4 a. The block of simulation model of predictive values of classification discriminant function of general competitiveness level is shown in Fig. 4 b.

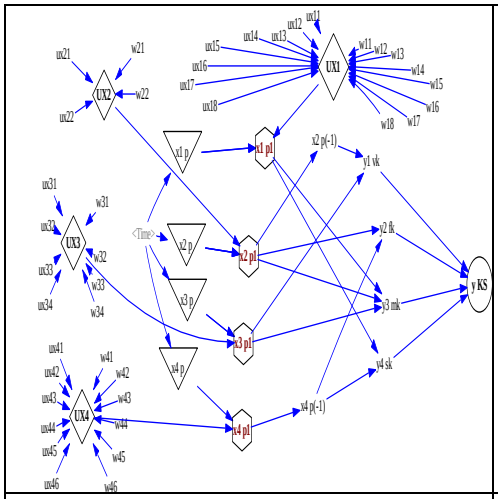

Fig. 4 a. The block of simulation model of the influence of organizational and management potential on the total integral competitiveness index

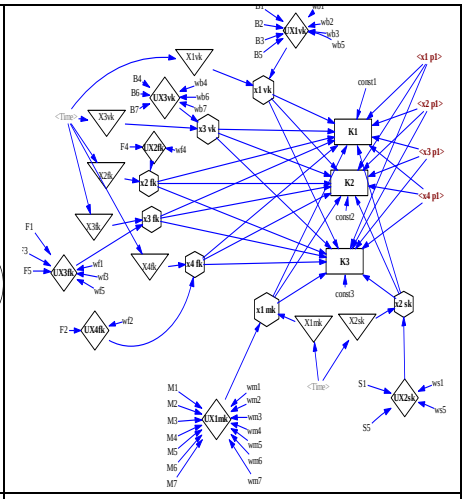

Fig. 4 b. The block of simulation model of predictive values of classification discriminant function of general competitiveness level

Two basic directions are at the core of modeling of competitiveness scenarios:

1. Forecast of the situation in the absence of exposure to it (self-development situation).
2. Forecast of the situation with the chosen vector of management impacts (direct problem).

According to these provisions the possible trajectories of competitiveness that meet the optimistic (O), realistic (R) and pessimistic (P) scenarios are determined. Key features of forecast development scenarios for machine-building enterprises are presented in Tab. 5.

The simulation results of predictive dynamics of competitiveness level of management scenarios (fragment) in *Vensim* for enterprise "Potential" which is the representant of the cluster № 3 (law level of organizational and management potential and competitiveness) is presented in Fig. 5.

Based on the results of scenario modeling the predicted scenario of competitiveness has the following characteristics:

1) for enterprise "Potential" which has a low level of organizational and management potential and competitiveness there is a slight increase of realistic scenarios (up 56% compared with the previous enterprises). There is not forecast of pessimistic scenarios, but optimistic scenarios can occur with probability of 20%. However, if we analyze the predicted level of competitiveness, it remains consistently low in all cases.

Table 5 - Key features of forecast development scenarios for machine-building enterprises

Scenarios	Criteria and factors of scenarios formation	Result of scenarios development
Pessimistic (conservative)	– the competitiveness integral index value for the scenario is below the corresponding value in the base scenario; – the least favorable combination of external and internal factors of machine-building enterprises taking into account the socio-political situation in the 2016-2017 years	– extensive development of machine-building enterprises; – the economy shift of machine-building industry in more unfavorable conditions compared to the actual state
Realistic (the most probable development)	– the competitiveness integral index value for the scenario equals the corresponding value in the base scenario; – taking into account of economic determinism of machine-building enterprises development	– gradual evolutionary improvement of individual elements of machine-building industry
Optimistic (scenario of steady development)	– the competitiveness integral index value for the scenario exceeds the corresponding value in the base scenario; – the most favorable combination of external and internal factors of machine-building enterprises taking into account the socio-political situation in the 2016-2017 years	– intensive development of machine-building industry; – formation of potential "growth points" within machine-building industry

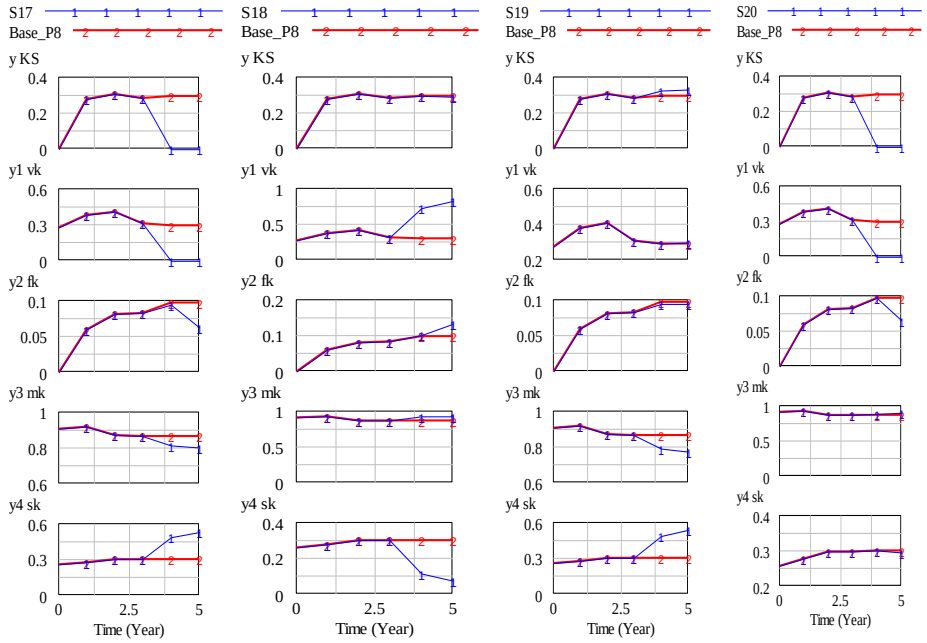

Fig. 5. The comparative analysis of baseline and other scenarios for enterprise "Potential"

2) for enterprise " Dniprovazhmash" which has an average level of organizational and management potential and competitiveness in half of cases there is a realistic scenario of

competitiveness development, 20% of the possible scenarios predicted an optimistic scenario and only in two cases (S9 and S10) are pessimistic scenario.

3) for enterprise Kharkiv machine-building plant "Light Miner" which has a high level of organizational and management potential and competitiveness in half of cases there is a realistic scenario of competitiveness, 25% of the possible scenarios predicted an optimistic and only in one case is pessimistic scenario.

So the steady trajectory of competitiveness for all clusters of enterprises is observed.

4. Conclusion

According to the results, we can conclude that the most influential factors are organizational and management nature, so the impact of management is necessary to adjust the competitiveness of machine-building enterprises and should be aimed at improving economic and social conditions of its formation.

Thus, the proposed complex of models of scenario management makes possible to develop the most effective strategy of competitiveness on the bases of ordered and verified knowledge of the investigated situation, because explains on what factor or several factors we should impact and force with which we should do it and in which direction to get desired changes of target factors.

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Construction of the Model Complex Index of Influence the Social Responsibility General Indicators on Productivity of the Enterprise Activity Using the Spline Interpolation

Ganna Zhosan[1], Sergii Kavun[2]

[1]Kherson national technical university, Kherson, Ukraine
ennzhosan@gmail.com, enn89@ukr.net

[2]Kharkiv Educational and Scientific Institute of the University of Banking,
Department of Information Technologies, Kharkiv, Ukraine
kavserg@gmail.com

Abstract. The impact of the complex index of social responsibility in general indicators proven productivity of the enterprise activity interpolation using spline interpolation of the third degree. This relationship is nonlinear. The economic-mathematical model of the impact of the complex index of social responsibility for synthesis rate productivity of the enterprise activity and displayed graphically.

Keywords. Social responsibility, Productivity developments, Developing process, Enterprise activity, Modelling.

1. Introduction

Social responsibility is a value company, affecting the improvement of financial and non-financial indicators of the company. A key benefit of implementing social responsibility programs is to create long-term and medium-term positive reputation in the eyes of members of internal and external business processes.

In the current economic conditions, social responsibility is defined as one of the main factors, which determines the performance of the company. Socially responsible enterprise is an integrated system, creates loyalty and commitment to customers is attractive for investments, increases confidence in the company, promotes the commitment of the state and the local community. Thanks to these benefits, the company is developing in all areas of activity (economic, environmental, social, legal) and in the medium term may get the opportunity to increase the impact of their activities, hence the relevance of the study.

2. Social responsibility in ensuring productivity of the enterprise activity

In today's economy, position that is more social affects the reputation and image of the company. Evaluating its activities should be considered not only operational and financial performance, but also how their functioning in the interests of participants in business processes. Confidence in the company expressed confidence in the declared values for compliance, stability, openness, honesty, integrity and respectable attitude to all participants of internal and external business processes. This is the basis for the formation of the institute of trust, which is particularly important in ensuring economic, environmental, social, labor and regulatory balance between the company, shareholders, directors, employees, consumers, suppliers, local community, and the state. Implementation of the principles of social

responsibility in business processes is a factor in the further development of the company and acquires paramount importance in solving a number of social problems.

The basic idea of social responsibility is that it can contribute to obtaining certain benefits now. Investments in its image and reputation although it does not bring quick profit, but in the future may provide a number of competitive advantages: the growth of the market, increased sales and profits, reduce risk, save operating costs and increase productivity and product quality, staff training, increase customer loyalty. That is, companies that are socially responsible activities can function more effectively. Consequently, improve social responsibility can influence the level of performance improvement activities, taking into account the achievement of economic, environmental, social and legal objectives of the enterprise. Reconciliation of interests of internal and external business processes with enterprise objectives in all areas of activity can enhance the efficiency of socially responsible and productive activity of the enterprise at the same time.

3. The essence of spline interpolation

The comprehensive social responsibility indicator and generalizing enterprise activity productivity indicator were being calculated on the previous research stages [1 -7]. The next research stage is the determination of relation for those indicators and a development the model of their dependence.

The new chapter of the modern mathematics, which calls the theory of splines, has rapidly developed in recent years. Splines allows to effectively solve the problems of experimental dependency processing among the parameters that have enough complex structure [8].

Equally, the rational interpolation and the spline interpolation are one of the polynomial interpolation alternatives.

The basis of the spline interpolation contains the following principle. The interpolation interval is divided into small segments (intervals), on each from which the function is given by the polynomial function of the third degree. The polynomial coefficients are chosen by certain conditions, which are fulfilled (depending on the interpolation method). Common to all types of splines of the third degree requirements are a continuation of this function and passing through the specified points [8].

The main advantages of spline interpolation are its stability and low complexity. Systems of linear equations, which have to solve for the spline constructing, allow obtaining the polynomial coefficients with high accuracy [8]. Because the social responsibility influence of the enterprise activity performance is the medium-term, and the spline interpolation of the third degree was being used for determination of their dependence model [9]. This step will allow not only determine a dependence for indicators, but also will establish what the period of time is need that an increasing of the enterprise social responsibility level will influence to the improvement of the performance level of its activity.

For this research, there are two data sets:

x is a set of the most comprehensive social responsibility indicators;

y is a set of the generalizing productivity [10] indicator of enterprise activity;

t is the time period (in this case, there are 2011–2015).

The system y(x) was being proposed, which is described with the help of the following parametric dependencies:

$$y(x) = \begin{cases} x = x(t) \\ \\ y = y(t) \end{cases} \quad (1)$$

The system y(x) and the influence models were being built with the help of computer mathematical package MapleTM. The program automatically determines the possibility of going through the experimental points. Therefore, the model accuracy rating is not required.

4. Influence Models Building of the Social Responsibility Level on the Enterprise Productivity Level

The individual economic and mathematical influence model of the comprehensive social responsibility indicator to the generalizing enterprise activity productivity indicator for 2011–2015 was being built based on a determination of this system. For example, economic and mathematical influence models in 2013 were presented in the Table 1.

Table 1. Economic and mathematical influence models of the comprehensive social responsibility indicator to the generalizing enterprise activity productivity indicator for 2012–2013.

Enterprise	Influence Model
Enterprise 1	$y(x) = \begin{cases} x(t) = 981,8332 - 0,4881t + 1,3279(t-2012)^2 - 0,4426(t-2012)^3, \\ y(t) = -399.6515 + 0,1988t + 0,0285(t-2012)^2 - 0,0095(t-2012)^3 \end{cases}$
Enterprise 2	$y(x) = \begin{cases} x(t) = 435,5865 - 0,2162t + 0,0224(t-2012)^2 - 0,0075(t-2012)^3 \\ y(t) = 108,9725 - 0,0541t + 0,2058(t-2012)^2 - 0,0686(t-2012)^3 \end{cases}$
Enterprise 3	$y(x) = \begin{cases} x(t) = -97,0971 + 0,0481t + 0,9474(t-2012)^2 - 0,3158(t-2012)^3 \\ y(t) = -55,0195 + 0,0274t - 0,0718(t-2012)^2 + 0,0239(t-2012)^3 \end{cases}$
Enterprise 4	$y(x) = \begin{cases} x(t) = 490,6061 - 0,2437t + 0,2528(t-2012)^2 - 0,0843(t-2012)^3 \\ y(t) = 337,8827 - 0,1678t + 0,0417(t-2012)^2 - 0,0139(t-2012)^3 \end{cases}$
Enterprise 5	$y(x) = \begin{cases} x(t) = -32.3830 + 0,0164t - 0,0255(t-2012)^2 + 0,0085(t-2012)^3 \\ y(t) = -143,3980 + 0,0714t - 0,4166(t-2012)^2 + 0,1389(t-2012)^3 \end{cases}$
Enterprise 6	$y(x) = \begin{cases} x(t) = 738,2731 - 0,3666t - 0,7422(t-2012)^2 + 0,2474(t-2012)^3 \\ y(t) = -33,5968 + 0,0169t - 0,3862(t-2012)^2 + 0,1287(t-2012)^3 \end{cases}$

The graphical interpretation of the economic and mathematical influence models of the comprehensive enterprise social responsibility indicator of the generalizing enterprise activity productivity indicator in 2011–2015 is shown in Fig. 1.

Based on a fact that the reference value for the researched parameters is 1, then the development dynamics of Enterprise 1 can be called positive (Fig. 1a) generally. This model clearly shows the enterprise activity productivity dependence from the social responsibility in the medium term. For example, the comprehensive social responsibility indicator has increased in 2015, but the enterprise activity productivity has increased only in 2014. However, this enterprise could increase its social responsibility in 2015 and this action has led to increasing of the generalizing activity productivity indicator.

The dynamics model of a dependence of the generalizing activity productivity indicator from the comprehensive social responsibility indicator for Enterprises 2 is not enough stable, as is shown in Figure 4b. In general, the enterprise activity productivity has quite low value, despite on the relatively high social responsibility indicator.

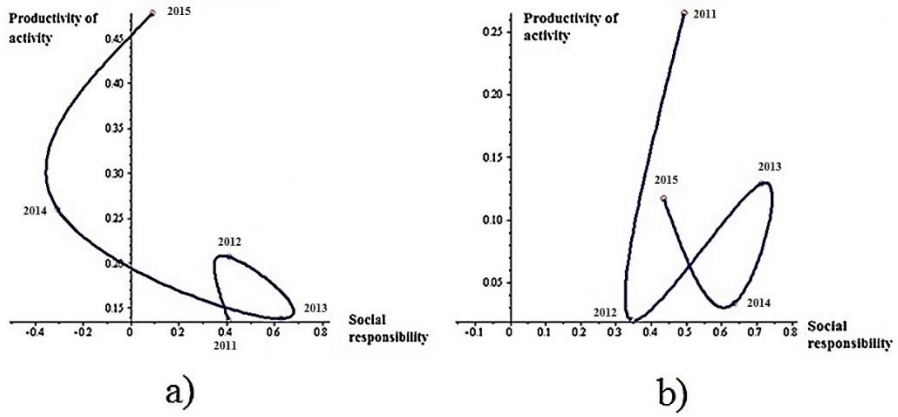

Fig. 1. The graphical interpretation of the economic and mathematical influence models of the comprehensive enterprise social responsibility indicator to the generalizing enterprise activity productivity indicator in time: (a) for Enterprise 1, (b) for Enterprise 2 (calculated and built by the authors)

The dependency of the indicators is observed in the medium term. However, the enterprise management rather inefficiently allocates expenses to the following:

Implementing some programs on reducing the energy consumption and energy intensity of production.

Increasing energy efficiency. Increasing expenses associated with the implementation of some programs to introduce new systems, quality standards, market research expenses, and establish a degree of customer satisfaction by product quality.

Distribution of investments related to the program implementation to support the territory presence and local community (aimed at the education development, health care, support for culture, arts, sports, non-profit organizations), and others [11 - 14].

Every time, expenses to the listed above program have increased after slight increasing of activity productivity. The sharp productivity drop has occurred in the next year. Thus, Enterprise 2 loses the level of enterprise activity productivity not calculating its opportunities.

Enterprise 4 (Figure 2a) has a negative dynamics of a dependence of the generalizing enterprise activity productivity indicator from the comprehensive social responsibility indicator, which steadily declining during researched period. Enterprise management [12 - 14] has not any possibility of funds investing in equipment modernization, staff development, and market research due to shortfall net profit. Through an enterprise management policy, the social responsibility and activity productivity levels are decreasing. Enterprise 4 needs an unpopular anti-crisis measures to get the net profit and, only after this action, we can re-pay attention to the social responsibility and the generalizing enterprise activity productivity indicator is lead to the reference value ‘1’.

Management of Enterprise 6 is quite irrational, led its policy of social responsibility. After sharply increasing its comprehensive indicator in 2011, the social responsibility indicator level has almost unchanged. This trend has led to productivity level fluctuations, which, after social responsibility level, is increased, then decreased again. If the enterprise’s management does not introduce new ways to enhance the social responsibility level, will not revise their policy about resource distribution, and spent money to the social initiatives, then the comprehensive social responsibility indicator can be reduced. Moreover, as a result, the generalizing activity productivity indicator can obtain a significant drop in the medium term, that happened in 2015.

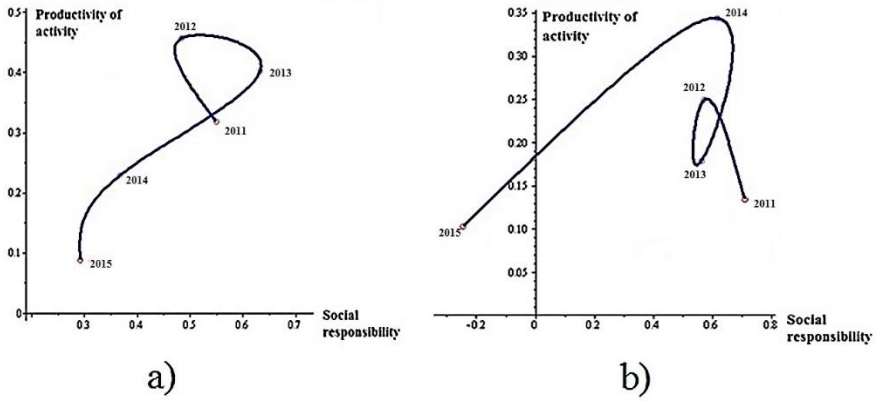

Fig. 2. The graphical interpretation of the economic and mathematical influence models of the comprehensive enterprise social responsibility indicator to the generalizing enterprise activity productivity indicator in time: (a) for Enterprise 4; (b) for Enterprise 6 (calculated and built by the authors).

5. Conclusion

To determine the impact of CSR on the performance of the company developed economic and mathematical model using spline interpolation of the third degree. It is possible to determine the dependence of the parameters and establish exactly what length of time required for this impact. The results suggest that increasing social responsibility contributes in the medium term (1-3 years) increase the level of performance of the company. This is due to growing confidence in the company by members of internal and external business processes.

This trend has led to productivity level fluctuations, which, after social responsibility level, is increased, then decreased again. If the enterprise's management does not introduce new ways to enhance the social responsibility level, will not revise their policy about resource distribution, and spent money to the social initiatives, then the comprehensive social responsibility indicator can be reduced. Moreover, as a result, the generalizing activity productivity indicator can obtain a significant drop in the medium term, which happened in 2015.

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Spatial Object Encoding Using Its Cross-sections

Tatyana Vlasova, Tetyana Romanenko

Institute of Mathematical Mashines and Systems, Kyiv, Ukraine
chery@immsp.kiev.ua , romanenko@immsp.kiev.ua

Abstract. Spatial object encoding using cross-section images, where object is described by pairs of control surfaces shapes and parameters is proposed. This description corresponds to spatial object model represented by two its 3-dimensional projections from 4-dimensional space.

Keywords. Spatial object, Images, Splines, Surface.

1. Introduction

This paper considers the method of coding the spatial objects taking into account the parameters characterizing the distribution of the properties of substance from which the object is composed.

As a rule a spatial object is considered as a bounded region of space with its boundary. However, there are areas where it is necessary to represent a spatial object together with some parameters varying within it. These areas include primaraly tomographic and histological studies of biological objects, in particular of the brain studies. Distributed parameters in this case are the density of the biological material, its color, etc. An actual task is to compare the results of tomographic and histological study of the object and its analytical description.

This paper considers the method for obtaining analytical description of a spatial object using the grayscale images of its cross-sections. Values of the monitoring parameter within the section correspond to brightness values in these images. It is assumed that the change in brightness levels within the images allows its approximation of a continuous function [1].

2. Analytical description of a spatial objects using regular control surfaces

In accordance with the model set out in detail in [6], a spatial object can be described by several pairs of form control surfaces and parameter control surfaces (hereinafter — the form surfaces and the parameter surfaces), represented as halftone images (Fig. 7A, Fig. 7b). Description of a spatial object in this case is formed by sequential coding of surfaces gray scale images with help of cubic splines [1, 3].

With halftone images of form and parameter surfaces, you can get a cross-section of a spatial object. The intersection of these two surfaces by the planes perpendicular to the *xOy* plane, forms in each of the planes the curves that in [6] have been called traces. A pair of traces of the form and parameter surfaces is shown in Fig.7a and 7b. These traces represent the control splines with help of which the cross-sections of a spatial object are formed.

For the case of three pairs of control surfaces the order of cross-section construction is as follows:

1. The traces of three form control surfaces as a function of $z(x)$ are defined (Fig.1b).

2. The traces of three parameter control surfaces as a function of *p(x)* are defined (Fig.1c).

3. A set of control points is defined in each column (Fig. 1d).

4. These control points are used to build parametric splines (cardinal splines) (Fig. 1d), which describe the dependence parameter *p* of *z* coordinate for each cross-section column.

5. The cross-section of a spatial object is formed from such columns (Fig.1a).

Thus constructed cross-section is represented as a grayscale image in which the value of the parameter *p* at each point of the cross-section corresponds to the level of brightness of the image points.

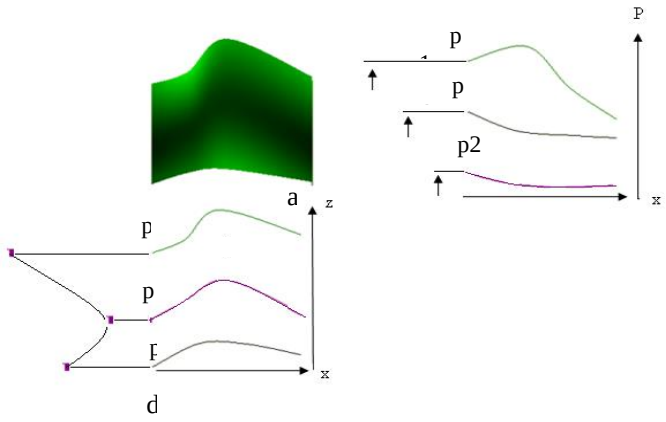

Fig.1. Halftone imaging of the object cross-section and calculation the characteristics of the first column points belonging to cross-section of the object.

a) Representation parameters of all points of the cross-section as brightness levels of halftone image.

b) Traces of all three surfaces of form as a result of their sectional plane parallel xOz.

c) Traces of all three surfaces of parameter as a result of their sectional plane parallel xOz (y=1).

d) Canonical curve graph used to determine the parameter value for all the points of the first column belonging to the cross-section of the object.

This paper considers the algorithm of the inverse problem — the construction of an analytical description of a spatial object from the available images of its sections.

3. Description of the encoding algorithm of a spatial object

3.1. Encoding the cross-sections of a spatial object

The model of a spatial object includes a description of a certain number of pairs of form control surfaces and parameter control surfaces [5]. These surfaces define the parameter distribution within a spatial object. For solving the inverse problem, i.e., the construction of a spatial object description from the available images of its cross-sections, it is necessary to identify all pairs of control surfaces.

Consider encoding of spatial object using as an example the images of its vertical cross-sections, i.e. cross-sections perpendicular to the plane *xOy*.

The cross-sections of the spatial object are represented as grayscale images, in which the value of the parameter *p* at each point of the cross-section corresponds to the level of brightness of the image points (Fig. 2a). We consider these images as surfaces where third coordinate is parameter *p*. We also assume that the function of the point's brightness and its derivatives within the countour, limiting each such cross-section image, are continuous. Consequently, each cross-section image may be encoded using cardinal splines [1, 4]. Image coding is performed by columns.

Each column *n* of image can be associated with a sequence of values *p (z)*, which reflects the dependence the brightness from *z* coordinate. This sequence can be approximated parametrically given analytical polynomial curve [2]. Such curve with its control points (the result of approximation for one cross-section column) is presented on Fig. 2b. In this example, the number of control points of the cardinal spline equal to three.

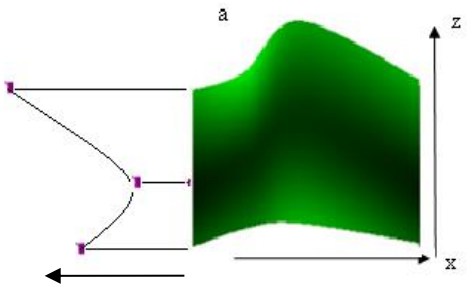

Fig.2. Encoding cross-section of a spatial object.
a) The original image of a spatial object cross-section,
b) The cardinal spline and its control points as a result of approximation of one column of a spatial object cross-section.

Similarly all cross-section columns are approximated. As a result we obtain an array of control points of the cardinal splines. This control points are used for construction of spatial control curves for cross-section image. As the number of control points in the example is equal to three, the number of spatial control curves also is equal to three. All first control points are approximated by a first spatial curve, all second control points are approximated by a second spatial curve and similarly for the third control points.

Projections of spatial curves describing the cross-section of a spatial object on the planes *xOz* and *xOp* are presented on Fig.3.

These projections are the traces of control surfaces with help of which a spatial object is described. Projections of spatial splines of cross-section image on the plane *xOz* are the traces of form control surfaces (Fig. 3b), and their projections on the plane *xOp* are the traces of parameter control surfaces (Fig. 3c).

After processing a set of spatial object cross-sections we get a lot of pairs of control surfaces traces. The cotrol surfaces can be reconstructed from these traces.

3.2. Construction of the control surfaces of a spatial object

Construction of the form control surfaces is proceeding as follows. As mentioned in paragraph 3.1, as a result of encoding every cross-section of a spatial object we get three spatial curves. To construct the form control surfaces we need projections of these curves on the plane *xOz*. Each of these projections is the trace of the corresponding form control surface.

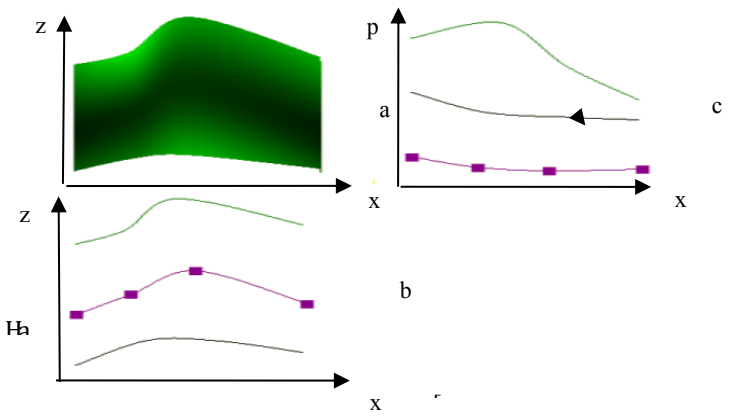

Fig.3. The result of encoding the image of a spatial object cross-section.
a) The original image of a spatial object cross-section,
b) The spatial splines projections on the plane xOz,
c) The spatial splines projections on the plane xOp.

After encoding of all cross-sections we obtain a set of such traces, from which the corresponding form control surface is composed. Because we consider the case of the description with help of three space curves, such form surfaces also will be three. Two of these surfaces bound a spatial object above and below, another one surface is located between them within the object. The form surface that bounds the bottom of the object (the lower form surface) is presented on the Fig.4.

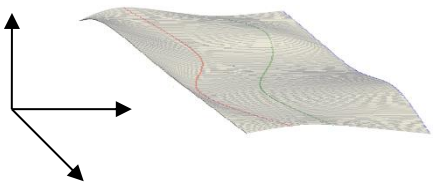

Fig.4. An example of the form surface building.
The set of lower traces forms the lower control form surface. Control curves for lower form surface consist from the set of control points for lower traces.

Each of the traces corresponding form control surface was approximated parametrically given analytical polynomial curve (Sec. 3.1). As a result, for each of them the values of the control points have been received, from which the spatial control curves are constructed for the lower form surface (Fig.4). For them the projection on the plane *xOy* and *zOy* are built, as it's shown on Fig. 5.

Projections of all control spatial curves in turn are approximated by cubic splines, which mean that each of the projections is presented by control points. If the projection of spatial curves is approximated by four points, then the full lower form surface description, shown on Fig. 4, will contain 32 control points.

On Fig. 6a three form surfaces of a spatial object are represented.

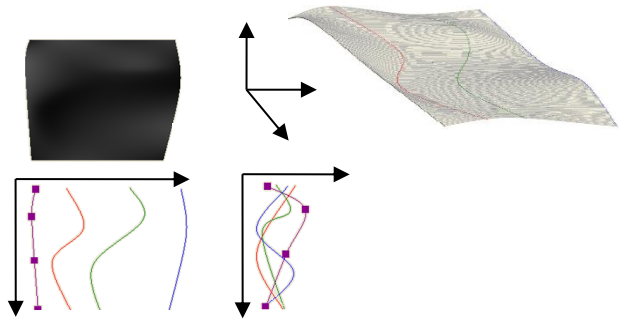

Fig.5. An example of the form surface and its spatial splines projections building.

a) grayscale image corresponding to the surface;

b) image presentation as a piece of a simple surface, and presentation of spatial splines, consist from the set of control points received as a result of spline approximation of all cross-sections of spatial object;

The algorithm for parameter control surfaces construction is similar to the algorithm described above for the form surfaces, only in this case the projections of spatial curves on the plane *xOp* are used (Fig. 3c).

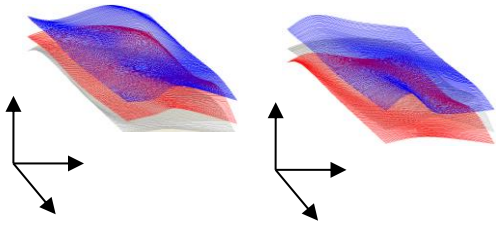

Fig.6. Construction of three form surfaces (a) and three parameter surfaces (b) based on the arrays of descriptions of spatial object cross-sections.

Thus each form surface can be associated with corresponding parameter surface and for describing a spatial object we have three pairs of control surfaces (Fig. 6). Every surface is described by 32 control points of corresponding approximating cubic splines. Therefore, to describe the spatial object represented by three pairs of control surfaces, you need 32 * 2 * 3 = 192 control points of approximating splines. In general, the number of control points is equal to 2 * N * N * 2 * M, where N is number of points in the approximating splines, M is the number of pairs of control surfaces.

3.3. The procedure for a spatial object encoding

1. Grayscale raster images of all cross-sections of a spatial object are used for encoding.
2. Every image is encoded by spatial curves [1]. The result of the encoding of cross-sections image is combined in corresponding arrays of a spatial object cross-sections description.

3. These arrays are used for analytical description of a spatial object in accordance with the spatial object model represented in the work [5].

4. Modeling and the ability to change the features of a spatial object

This paper considers a spatial object, specified by vertical cross-sections represented by grayscale images, which is described by several pairs of connected surfaces, called control form surfaces and control parameter surfaces. The paper [5] considers a spatial object initially specified by pairs of connected form surfaces (Fig. 7a) and parameter surfaces (Fig. 7b) given by grayscale images. Description of a spatial object in this case is formed by the sequential coding of grayscale images of these surfaces [5], and coding results may be used to construct any cross-section of a spatial object, both vertical, i.e. perpendicular to plane *xOy* and horizontal, parallel to this plane.

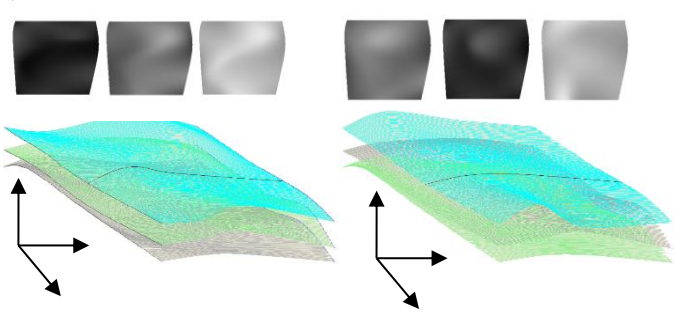

Fig.7. Presentations of form surfaces (a) and parameter surfaces (b) as the grayscale images

Both variants encode of a spatial object give its description in compact format, saved to the files.

The software, which implements the algorithm, also allows you to change any control surface that allows you to get a description of a new spatial object.

Visualization of any cross-section of a spatial object is possible, both vertical and horizontal (Fig. 8, 9), as well as visualization of the control form and parameter surfaces, obtained as a result of coding.

Fig.8. Result of construction of several images of vertical cross-sections of a spatial object.

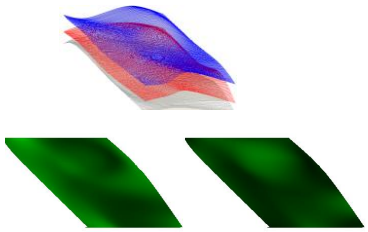

Fig.9. Result of images construction of horizontal cross-sections of a spatial object.

The proposed algorithm can be used in encoding of the vertical cross-sections of a spatial object, characterized by several parameters, by the cubic splines. A color image of the cross-section of a spatial object and the result of its approximation by the cubic splines are presented on the Fig.10.

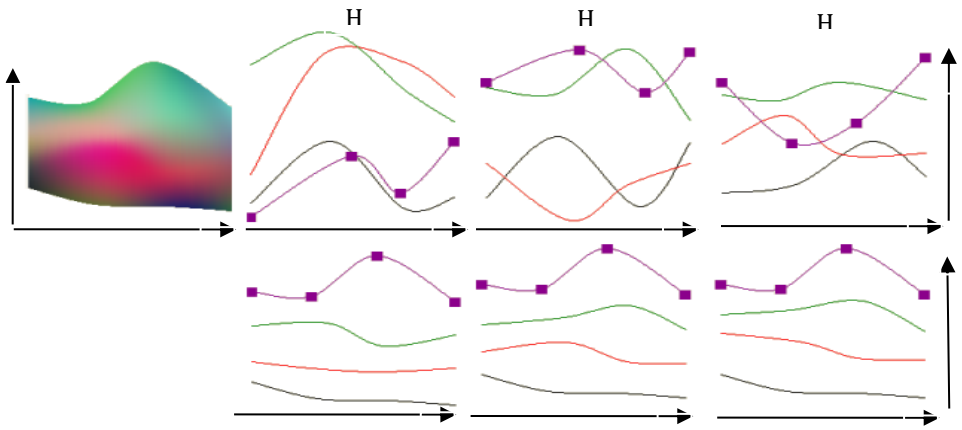

Fig.10. A color image of the cross-section of a spatial object and the result of its approximation by the cubic splines:
- the original color image of a spatial object cross-section
- the spatial splines projections on the plane xOp
- the spatial splines projections on the plane xOz
In the color cross-section image the brightness levels of cross-section points are used as the three parameters for (R), (G), (B).

In this case the description of the spatial object, characterized by the proposed three parameters - a parameter (R), a parameter (G), a parameter (B), consists of three descriptions of the above-presented spatial object [6].

5. Conclusion

Provided studies have shown the possibility of encoding a spatial object using grayscale images of its cross-sections. Developed software allows building a complete description of a spatial object, which consists of several pairs of control form and parameter surfaces, from array of encoded cross-section images of the object.

To describe the spatial object with several independent parameters, a full description of the spatial object with a single parameter should be used for each of parameters.

The developed software can be used both for editing the descriptions of the spatial objects and for obtaining the descriptions of the new spatial objects. Visualization of all cross-sections of the spatial object and its control surfaces is provided.

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Segmentation of the Experimental Curves as the Implementations of Unknown Piecewise Smooth Functions

Vladimir Kalmykov[1], Anton Sharypanov[2]

[1] IMMSP, Kiev, Ukraine
vl.kalmykov@gmail.com

[2] ICYB, Kiev, Ukraine
sha@ukr.net

Abstract. While processing (e.g. spline approximation) of experimental curves that supposed to be implementations of piecewise smooth functions distorted by noise, the task of determining the boundary points of the pieces arises. A suitable resolution for examining each curve is unknown. Construction of partial answers at a number of increasing resolutions is proposed. Each partial answer contains information about specific points found at a given resolution. The general answer is a subset of maximum cardinality of sequential and not conflicting partial answers. The results of experiments on segmentation of curves based on proposed method are discussed.

Keywords. Experimental curves, Segmentation, Coarse-to-fine.

1. Introduction

Most information systems accumulate information in the form of various graphs, various kinds of images, which are required to obtain the opinion of the expert, in other words, to take this or that decision. A large and constantly growing volume of data is forcing the development of tools that allow reducing the burden on the decision-makers through automatic and/or automated processing of raw data.

The initial data or experimental curves represent the measurement results that are usually distorted by interference. It is assumed that the measured data is the representation of some unknown function $y = f(x)$, that is defined on measuring range $[a, b]$. Measurement result is a finite sequence of I pairs $\{x_i, y_i\}$; $i = 1, 2 \ldots I$. In other words, there is a tabular implementation of a given function.

Graphs, contours of objects on images seems to be the simplest and long used method for cognitive presentation of measurements in various areas of human activity, which allow to evaluate the qualitative properties of the process despite on the interference and measurement error. The most basic feature of a graph or contour is its shape, which reflects a function that generates a visible representation of the curve. It is the form of graphic curve that characterizes parameters of the reflected object or process. Various representations can vary in scale, in the number of measurements, and in other affine transformations. Furthermore, they may be distorted by noise. However, the main features of the form are preserved. Automatic (automated) processing of graphical representation of unknown functions implementations involves comparing their forms to determine if they describe the same or different processes or objects. For that purpose an analytical representation of an object should be obtained, e.g. in the form of parametrically defined splines [1,2].

However, the methods of presentation of the experimental curves by splines suggest that obtained experimental curves represent processes or phenomena that are determined by

unknown smooth functions. At the same time a large number of practical problems require processing of the experimental curves that can not be represented by smooth functions adequately. Apparently, these graphs are the representations of the processes determined by the unknown piecewise smooth function.

It is natural to assume that the approximating function must also be piecewise smooth. The curve defined by the function $y = f(x)$, $(a \le x \le b)$ is piecewise smooth if the function $y = f(x)$ has a finite number of discontinuities on $[a, b]$ and the segment $[a, b]$ can be divided by points into a finite number N of partial segments, so that the function $y = f(x)$ has continuous derivatives not equal to zero simultaneously on each segment.

If splines are selected as approximating function, this function takes the form of a sequence of polynomials

$$y = f^{(1)}(x)\,|\,(t_0 \le x < t_1),\ f^{(2)}(x)\,|\,(t_1 \le x < t_2),\ \ldots,\ f^{(N-1)}(x)\,|\,(t_{N-1} \le x \le t_N),$$ where

$$f(x)\,|\,(t_n \le x < t_{n+1}) = a_0^{(n)}x^k + a_1^{(n)}x^{k-1} + \ldots + a_{k-1}^{(n)}x + a_k^{(n)}.$$

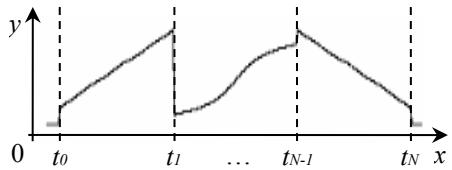

Fig. 1. Segmentation of experimental curve.

Thus, it is necessary to consider a set of boundary points $T=\{t_0, t_1, \ldots, t_N\}$ and their number $N+1$ in order to segment the experimental curve (Fig. 1).

The phenomenon of selecting the separate segments on a graph is an act of visual perception by its nature. The discontinuities of the curve or its gradient are identified visually and used for making decisions. The segmentation of images (i.e. object contour selection) presumably has the same nature as graph segmentation.

2. Image processing methods that use changes in resolution

Usually image processing systems deal with an image distorted by noise. In the simplest case input image is convolved with (typically) Gaussian filter in order to remove unwanted details and processing algorithm is applied to blurred image. For example Canny edge detector [3] relays on that processing procedure. The result depends on σ parameter of Gaussian filter (Figure 2). No recommendations were issued in original work on how to choose that parameter.

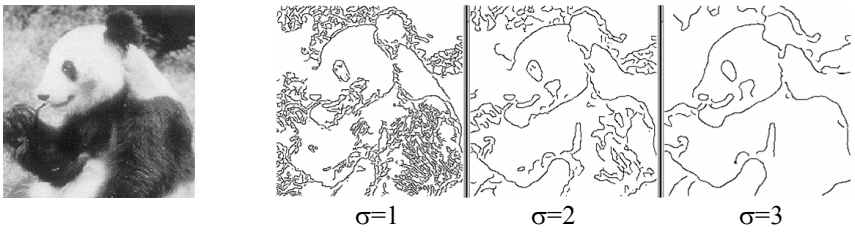

Fig. 2. Application of Canny edge detector with different values of σ to an image.

Other filters can also be used during signal preprocessing aiming at removing noise from the original signal. The result depends on the apperture size of the filter which is the unknown parameter.

It was shown in [4] that processing of artificially blurred images allows to solve problems that can not be addressed at all by traditional image recognition methods but nothing was said about choosing the reasonable degree of that blur.

In some fields of science it is not possible to get sharp image at one shot. In biological imaging with conventional light microscopy a problem of limited depth of focus exists. If the specimen is thicker than attainable focal depth portions of the object surface outside the focal plane will be defocused. To overcome this, multiple shots of specimen are taken with different focal depth along optical axis resulting in series of images where the certain parts of specimen appear in and out of focus. After that a procedure of reconstruction from image set involving wavelets follows in order to obtain an image that is sharp everywhere [5].

However, blurring of an image may be considered as decreasing of physical resolution. At the same time decreasing of physical resolution is widely used to reduce the computational complexity of existing image processing algorithms in order to get performance gain.

In [6] proposed a multi-resolution part based model and a corresponding coarse-to-fine inference algorithm. It is based on the observation that matching of each part of the image is the most expensive computational operation in comparison to detection of significant parts and computation of their optimal configuration, so the minimization of number of part-to-image comparisons implies detection acceleration. Starting from matching the lowest resolution part the method selects only the best placement in each image neighborhood. These locally optimal placements are then propagated recursively to the parts at higher resolution. By recursive elimination of unlikely part placements from the search space, the set of possible locations is narrowed so that the computation of only few part-to-image comparisons is performed. This method gives a ten-fold speed-up over the standard dynamic programming approach.

The task of establishing the correspondence between pixels in two images (finding a markup) with human faces, addressed in [7], is effectively solved by building "cascades" of markups. The resolution is decreased two times in both initial images per cascade and new markup for them is built. After that the starting approximation for initial markup is defined based on the new markup and the field of motion is searched but with less quantity of markings. The algorithm that solve the task utilizing one "cascade" runs eight times faster while preserving accuracy in finding the field of motion for two images.

As we can see, several fixed decreased resolutions relative to resolution of original image are taken and transition rules are introduced but the best resolution for processing particular image or its part is never estimated.

3. Necessary additional mathematics and neurophysiology information

We will conduct our research based on the classical definition of the continuity of functions and new findings in the field of neurophysiology of vision.

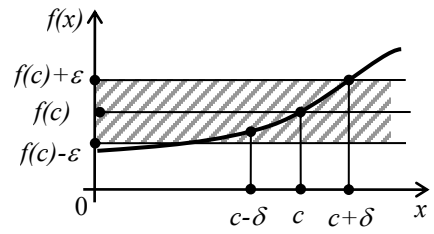

Fig. 3. Function continuity in ε-δ form

The definition of function continuity in ε-δ form states that if for every $\varepsilon>0$ there exists a $\delta>0$ such that for all values of variable x from δ-neighborhood of point c the function values $f(x)$ belong to ε-neighborhood of $f(c)$ (Figure 3).

This definition is used successfully for function analysis but it could not be used in analysis of experimental curves. Experimental curves are the representations of respective unknown functions presented as sequences of measurements. A sequence of measurements is a set of points in some discrete space. We note only that for checking the continuity condition of $f(x)$ in a given point c the sequence of function values considers. Starting from a specific value $|x_1-c|$ the neighborhood of point c

reduces ($|x_1-c|>|x_2-c|$, $|x_2-c|>|x_3-c|$, …) tending to 0. *f(x)* considers continuous in *c* if the neighborhood of *f(c)* reduces to 0 at the same time ($|f(x_1)-f(c)|>|f(x_2)-f(c)|$, $|f(x_2)-f(c)|>|f(x_3)-f(c)|$, …). So, changing neighborhood of *c* is used for analysis of function continuity in a given point.

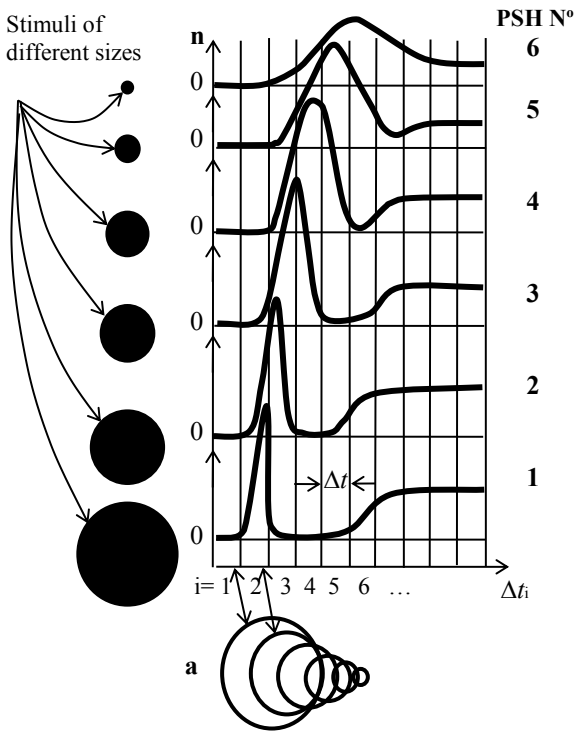

Fig. 4. [9]. Post stimulus histograms of neuron responses on stimuli of 6 different sizes

***n** axes represents the number of spikes in corresponding time slice Δt_i. Maximum number of spikes corresponds to interval where the size of stimulus meets the excitatory zone size.*

***a** – decreasing of receptive field's excitatory zone area during visual act.*

While studying human vision and processes which take place in visual system neurophysiologists discovered that visual neurons process signals from a set of receptors that form receptive field of a neuron. The simplest receptive fields are circle in shape and discrete by their nature. Receptive fields of neighboring neurons overlap [8]. Later it was discovered that the excitatory zone of the receptive field doesn't stay constant during a visual act (approx. 150ms). It decreases from maximum to 1-2 receptors wide (Figure 4). After awhile this phenomenon was carefully investigated in [10]. It was also shown in [10] that the number of neurons being activated decrease during stimulation of visual act. Eccentric stimulus spot presented outside minimum field center but inside maximum field center gave a fast initial response that disappeared as center shrank toward minimum.

Thus it is possible to assume that visual neuron could be matched to a point in some discrete two-dimensional space and the excitatory zone of the neuron could be matched to discrete representation of point neighborhood. Then changes in receptive field excitatory zone could be matched to changes in point neighborhood. During one visual act image processing of the object in the field of view proceeds in visual system with different resolution changing from minimal (coarse, blurred) to maximal (sharp image). Because of the fact that we do not notice the process of image segmentation of the object in the field of view, it could be supposed that image preprocessing in visual system happens on subconscious level thanks to changes in size of visual neurons receptive field excitatory zone as well. Mentioned above phenomena being observed in visual system of living beings could be used to prototype a new method of signal processing based on variable resolution concept.

4. Proposed algorithm

Statement of the problem: there exists an unknown function $y = f(x)$ with domain bounded to $[a, b]$. The image of this function is observed on $[a, b]$. The resolution needed for analyzing the image of this function is unknown. Under the assumption that the given image of a function represents an unknown piecewise smooth function, the boundaries of partial segments $a = t_0 < t_1 < \ldots < t_N = b$ and their number $N+1$ should be found.

Analytical solution of the segmentation problem stated above should be considered as finding the points of discontinuity for unknown piecewise smooth function. The following discontinuities are of interest: jump discontinuities, when the ε-neighborhood of the function is empty in a given point and removable discontinuities when the first order derivative of function does not exist in the given point (jump discontinuity of function gradient). However only the image of unknown piecewise smooth function is observed so we are allowed to consider only the discrete analog of discontinuities in the form of irregular points on experimental curve.

Preliminary stage consists of presenting the experimental data as I "reference-value" pairs $\{i, x_i\}$; $i = 1, 2 \ldots I$, that corresponds to maximum resolution. Acquisition of coarse resolution signal is performed (as well as in visual system) using a source signal with maximum resolution. The following initial conditions are set in algorithm that implements this method:

1. Maximum neighborhood size of an arbitrary reference i for the coarsest resolution is taken as $s_0 \sim I / 10$.

2. List of M resolutions is used with neighborhood sizes of $s_0, s_1, s_2, \ldots, s_m, \ldots, s_M$; $s_{m+1} = k \cdot s_m$. In this case the value of k is 0.67. The M-th list item corresponds to source sequence with maximum resolution. M can be calculated based on s_0 and k.

3. The total number of values in the sequence corresponding to resolution s_m is $N_m = 3 \cdot (I / s_m + 4)$ considering the mutual intersection of adjacent samples neighborhoods and additional points at the beginning and at the end of experimental curve in order to deal with border effects.

4. $g(s_m)$ is the curve for resolution s_m. Its n-th value $g_n(s_m)$ is calculated as median of values $\overline{x_i, x_s}$ for the sequence of references $i, i+1, \ldots, i+s_m$ in experimental curve.

5. The points of $g(s_m)$ being calculated with non-overlapping neighborhoods are considered. Irregular points $r_n(t_m)$, $(t_m = 1, 2, \ldots, T_m)$ are fixed based on analysis of curves $g(s_m) : | g_n(s_m) - g_{n-3}(s_m) | > d$ and $g'(s_m) : g'_n(s_m) = | g_n(s_m) - g_{n-3}(s_m) |$; $| g'_n(s_m) - g'_{n-3}(s_m) | > d$. Here d is some predefined threshold.

6. Application of rules from item 5 to curves $g(s)$ and $g'(s)$ for all M resolutions results in a list of irregular points sequences $r(T)$. Each sequence includes all irregular points $r(T_m)$ of curves $g(s_m)$ and $g'(s_m)$ for a given resolution s_m.

7. Irregular point $r_n(t_{m+1})$ from sequence $m+1$ corresponds to irregular point $r_n(t_m)$ from sequence m respectively if $r_n(t_m) \le r_n(t_{m+1}) \le r_n(t_m) + s_m$ is true.

8. Sequences m and $m+1$ are grouped together in a sublist if they have equal number of irregular points T_m and the correspondence condition for each pair of respective irregular points is fulfilled. If sequence m already belongs to another sublist then sequence $m+1$ is added to that same sublist.

The result of segmentation is considered as sequence of irregular points with the largest resolution number m being taken from the longest sublist.

5. Results

Proposed algorithm was experimentally checked in MATLAB development environment.

The graphs of line brightness in grayscale images were selected as objects of concern (Figure 5a-f). Figure 5g-i shows the application of proposed algorithm to original graph where the resolution (apperture size) changes from coarse (large values) to fine (small values). X-axis of Figure 5g-i contains references of original signal (Figure 5d-f respectively). Y-axis of Figure 5g-i contains resolution numbers in a list of resolutions so each horizontal line on them represents the sequence of irregular points for a given resolution. Sublists of partial answers are marked by vertical gray dashed lines on the sides of each graph and the longest sublists are marked in black.

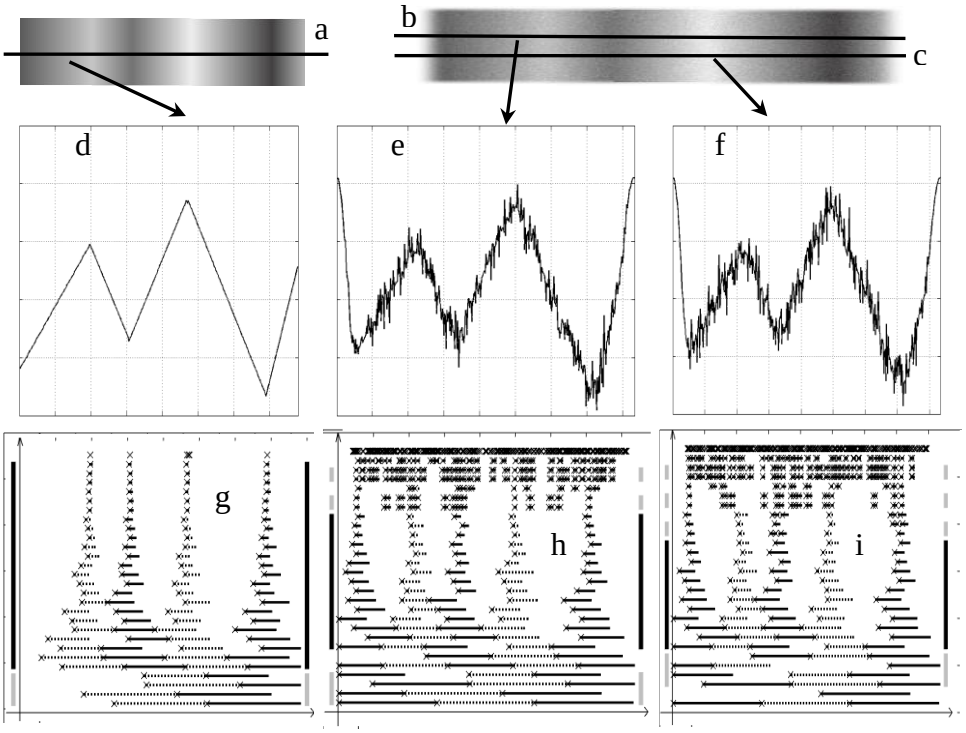

Fig. 5. Generation of segmentation answers for brightness graphs of image lines
1. Lines in a) ideal image b),c) image distorted by noise and their corresponding graphs of brightness d), e), f).
2. g), h), i) the results of segmentation for each graph

In contrast to other known methods of segmentation the proposed algorithm doesn't use any a priori information about noise level etc. for the graph been processed.

6. Conclusion

For the first time it was proposed and experimentally verified curve segmentation algorithm that used variable resolution (coarse-to-fine) in the decision-making process. Similar principle was found and studied in the visual system of animals. Using the "coarse-to-fine"

principle it is possible to successfully execute segmentation of experimental curves distorted by noise, which are the implementations of piecewise smooth functions.

The resolution of signal was considered as a hidden parameter. It was shown that proposed algorithm was capable of obtaining results of segmentation based on artificially acquired information about image resolution. No additional a priori information about noise level was used while processing graphs distorted by noise.

These solutions will be used in the development of new methods for processing halftone images.

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Knowledge Model for Decision Support System Security Management

Oleksii E. Kovalenko, Taras Kovalenko

IMMSP NASU, Kyiv, Ukraine
koval@immsp.kiev.ua , taraspatriot1991@gmail.com

Abstract. The paper reviews current state in security management methods and standards. Key aspects of security management are pointed. The concept of mutual dependence on risks, threats and security architecture is proposed. The structure and components of formal knowledge model for decision support system security management are outlined. Promising directions for future research are outlined.

Keywords. Decision support system, Security management, Knowledge model, Ontology.

1. Introduction

Security management is important part of business activity. Decision support is a kind of specific business activity concerned with multi aspect analysis of threats, risks and vulnerabilities for organization functioning. Thus, security management needs support of knowledge depository, particularly, in the form of knowledge base.

2. The analysis of the current state of research and publications

One of the ways for use knowledge base in security management is ‘ontology-based security approach’, which creates a conceptual relationship among entities representing information, having systematic review for the purpose of identifying, analyzing and eliciting security countermeasures. Many international and other standards of security and protection define rules for assessment risks and preparing of protection profiles and security targets.

3. Statement of the problem

There are not unified recommendations for creating security and protection systems for enterprise. Each case is unique and specific. Hence, the process of creating security and protection systems for enterprise will be more effective with use of knowledgebase. The issue of structure of knowledge base is major and concerned with taking into account variety of different factors. One of the most citing work on security ontology [1] and last work [2] are based on asset-centered approach to security management. Systematic point of view on information security requires of integrated accounting various assets of organization and its security attributes. Such systematic approach may be realized with the use of different models.

4. The main problem

Each type of organization is needs adequate manner of security and protection. System of situational management is a specific type of organization and includes decision support system(s) as its component. There are many of international standards concerned with

development, creating and implementation of security management systems. But all of them bring out only general recommendations about different aspects for organizing of system security and protection. Creation of working system of security management needs using supporting tools, and, particularly, knowledge base. Development of adequate model of knowledge base for system security management is the main issue of this paper.

5. Model of Security Management System Knowledge Base

General approach to security management stated in standards is the risk-oriented approach. Hence, the main objective of security management is risk minimizing. There are many definitions of risk. In particular, ISO/IEC 27005 standard defines risk as "effect of uncertainty on objectives" and *note 6* to this definition tells "information security risk is associated with the potential that threats will exploit vulnerabilities of an information asset or group of information assets and thereby cause harm to an organization" [3]. Moreover, in ISO/IEC 27005 standard context "vulnerabilities can be related to properties of the asset that can be used in a way, or for a purpose, other than that intended when the asset was purchased or made" [3], or simpler vulnerability is a weakness of an asset or group of assets that can be exploited by one or more threats, but a threat that does not have a corresponding vulnerability may not result in a risk. And eventually, "risk assessment determines the value of the information assets, identifies the applicable threats and vulnerabilities that exist (or could exist), identifies the existing controls and their effect on the risk identified, determines the potential consequences and finally prioritizes the derived risks and ranks them against the risk evaluation criteria set in the context establishment" [3]. Therefore, dependencies between risks, threats, vulnerabilities and information assets may be represented by the diagram depicted on fig.1.

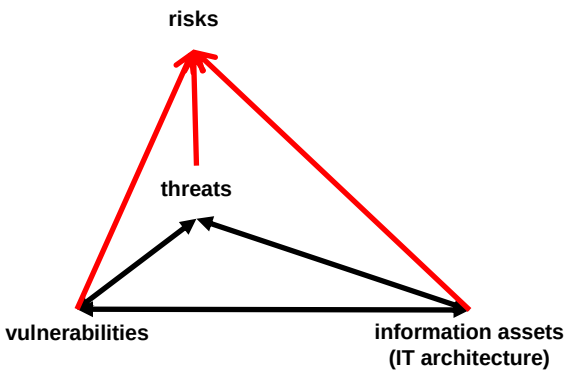

Fig.1. Dependencies between risks, threats, vulnerabilities and information assets

Risk assessment is a basis for security management and using adequate set of security models [4]. Information assets are parts of IT architecture. So, telling about information assets we consider these assets as concretization IT architecture. Risk factors concerned with threats, vulnerabilities and IT architecture are describing by the models. In statistical sense the risk is the expected value of threat realization aimed at the information asset with the use of vulnerability. Mathematically IT risk is described as expected value of loss function, concerned with the loss of information asset. Therefore, for definition of loss function we must determine the effect of threat realization through vulnerability, concerned with information asset. Existing methods of risk analysis are based on *quantitative*, *qualitative*, and hybrid

(semi-quantitative) paradigm [5] and use model based approach. There are many models for each component of risk dependencies and security organization. Information security management system (ISMS) is based on balanced accounting of risks and using of adequate controls for achieving of activity objectives. Hence, analyze and decision making in issues of ISMS constructing is complex knowledge oriented problem and needs using the knowledgebase about different components of information security. Knowledge about each component of ISMS are grounded on its taxonomy. Let us consider these components and taxonomy.

Assets and vulnerabilities. Vulnerabilities are related in ISO 27005 [3] standard with properties of the asset and may be classified according to the *asset type* concerned with:

- organization;
- processes and procedures;
- management routines;
- personnel;
- physical environment;
- information system configuration;
- hardware, software or communications equipment;
- dependence on external parties.

Threats. One of the most complete threat taxonomy is ENISA Threat Taxonomy [6]. This taxonomy is based on types of threats:

- legal;
- nefarious activity/abuse;
- eavesdropping/interception/hijacking;
- outages;
- physical attacks;
- unintentional damages (accidental);
- disasters;
- damage/loss (IT assets);
- failures/malfunctions.

Risk. Information security risk assessment (ISRA) is a major part of an Information Security Management System (ISMS). Risk assessment taxonomy may be based on various approaches. One of last taxonomy [5] is based on four approaches:

- appraisement;
- perspective;
- resource valuation;
- risk measurement.

Integrated view of a set of organization assets exposed to threats is based on the use of fundamental structure for *enterprise architecture* which provides a formal and structured way of viewing and defining an enterprise. This fundamental structure is represented by enterprise ontology. One of the most comprehensive enterprise ontology is the Zachman Framework (ZF) [7]. Generally ZF may be represented as matrix:

$$Z_F = A \times P,$$

where A – is asset category with interrogative characteristic; P – is point of view perspective for describing of different aspects of enterprise activity and its existence. Because Z_F is enterprise ontology then for adopting this model for particular use we must define concrete semantic of abstract ontology components:

$$O=\langle C, T, I, R, F, D, S, A, E\rangle,$$

where *C* - *classes* i.e. sets, collections, concepts, classes in programming, types of objects, or kinds of things; *T* - *attributes* i.e. aspects, properties, features, characteristics, or parameters that objects (and classes) can have; *I* – individuals i.e. instances or objects (the basic or "ground level" objects); *R* – *relations* i.e. ways in which classes and individuals can be related to one another; *F* - *function terms* i.e. complex structures formed from certain relations that can be used in place of an individual term in a statement; *E* – *restrictions* i.e. formally stated descriptions of what must be true in order for some assertion to be accepted as input; *S* – *rules* i.e. statements in the form of an if-then (antecedent-consequent) sentence that describe the logical inferences that can be drawn from an assertion in a particular form; *A* – *axioms* i.e. assertions (including rules) in a logical form that together comprise the overall theory that the ontology describes in its domain of application; *E* – *events* i.e. the changing of attributes or relations.

The paradigm of security management was changed from ISO 27001-2005 till ISO 27001-2013 standard. Newer ISO 27001-2013 does not emphasize on the Plan-Do-Check-Act (PDCA) cycle that 27001:2005 did and pays more attention to the organizational context of information security with changing of risk assessment.

Domain ontology for security management of organization includes main categories of assets defined in enterprise architecture and risks concerned with them. In general asset is 'a resource with economic value that an individual, corporation or country owns or controls with the expectation that it will provide future benefit' [8].

Hence, organization centered approach to security management is based on model of organization. Different types of organizations have different concrete classes of attributes that describes its specific features. For example, formal model for one type of decision support system (DSS) known as a system of situational management (SSM) was proposed in work [9]. According to [9] formal model of DSS/SSM activity is based on determination of DSS/SSM category model M_K, organizational model parameters M_O, architectural model M_A, processing (functional) model M_F, logical model (including model of modalities) M_L:

$$W=\langle M_K; M_O; M_A; M_F; M_L\rangle. \quad (1)$$

Accordingly to (1) integrated model of risks will be:

$$R_W=\langle R_K; R_O; R_A; R_F; R_L\rangle.$$

where R_K – risks for specific category of DSS; R_O – risks for organizational components of DSS; R_A – risks for architectural components of DSS; R_F – risks for functioning of DSS; R_L – risks for correctness of logical assertions for inference in DSS.

Risks R_K for specific category are concerned with mission, objectives and tasks of DSS functioning and take into account composition of classification parameters groups. The first (general) group contains parameters of aim mission, subject domain, scale and tasks determinacy. Parameters of second group determine control aspects of DSS functioning, in particular, subordination, staff, and methods of situational information processing, and time restrictions for decision making. Third group parameters define constructive specifics of DSS and contain deployment technique, universality, number and type of physical locations etc. Fourth group parameters define engineering and technological aspects of DSS functioning with technical equipment list, situation modeling tools nomenclature, using technologies, security level, grade of automation of situational assessment etc.

Risks R_O for organizational components of DSS are defined by main coordination mechanism, organization core type (main part), general design parameters and situational factors (motivations).

Risks R_A for architectural components of DSS are defined by chosen architectural pattern (framework) for modeling of DSS architecture. In particular, according to Zachman Framework for Information Systems Architecture [7] risks are concerned with six aspects of architectural representation system description:

- motivational intentions, organization's goals and basic rules by which it operates and which determine its activity;
- personnel, units and other elements of the organizational structure, relations between them, the distribution of powers and responsibilities within the organization structure;
- entities and data handled by the organization and a list of tools that are used for this;
- performed by the organization and its various departments functions and operations on the data, and processes that implement them;
- spatial distribution of elements and relationships between remote parts of it, within the distribution network of the organization;
- time characteristics and limits on the organization functioning, events, appreciable for its coordinated activities that meet the implementation of processes time cycles in the organization.

Risks R_F for functioning of DSS are concerned with information flows between components of organizational structure.

Risks R_L for correctness of logical assertions for inference in DSS are concerned with incompleteness of problem formulation, with errors and inaccuracy in logical models of inference and processes of decision making.

The main sense of information security management is risk management. The newest draft of security standard NIST Special Publication 800-12 [10] is proposing Risk Management Framework (RMF). The six steps that comprise security process S_P in the RMF include:

1) S_C – Security Categorization;
2) S_S – Security Control Selection;
3) S_I – Security Control Implementation;
4) S_A – Security Control Assessment;
5) S_U – System Authorization;
6) S_M – Security Control Monitoring.

These six steps must be adopted for above defined types of risks in DSS. Consequently, knowledge model for DSS risk management is represented as:

$$M_R \mid= R_W.S_P \tag{2}$$

Other security standard ISO 15408-2 [11] depict a wide range of functional components of security and theirs coding. Denote set of functional components of security as F_S. Hence, model (2) taking into account the set of functional components of security and interpretation function $.^I$ is presented as:

$$M_R \mid= R_W.S_P.F_S^I,$$

where R_W – concept of integrated model of risks; S_P – concept of integrated model of security process; F_S^I – concept of integrated functional components of security with interpretation function $.^I$.

Future research on creating knowledge model for decision support system security management will be concerned with concretizing of interpretation function for functional components of security and clarification of the meaning of the concepts of the knowledge model. Creating of adapted ontology for decision support system security management is planned.

6. Conclusion

The proposed model for decision support system security management includes set of concepts represented the union of the constituent parts of security management: integrated model of risks; integrated model of security process; integrated functional components of security. The relationship between concepts and categories knowledge base determine the sense of security management and functions define the rules of interpretation superposition of the compound models.

Development of knowledge models for decision support system security management is associated with the activity support of these systems in accordance to their purpose. In the paper proposed the metamodel of integration of formal security models based on description logic. These models in the aggregate describe aspects of security management activity. Taken into account the key components of the security management activity for decision support system and was proposed methods to implement them.

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Hidden Markov Model's Applications in Cyclic Development Modeling

Lidiya Guryanova, Natalia Chernova

S. Kuznets KNUE, Kharkiv, Ukraine
g_lika@list.ru, natacherchum@gmail.com

Abstract. The paper presents an alternative vision of the problem of modeling the cyclic development and forecasting the type of the stage of the economic cycle. The suggested algorithm bases on the theory of hidden markov processes and includes two blocks: cyclic development analysis and cyclic development forecasting. Hidden markov model consists of two types of variables: unobservable hidden variable and variable, which is observable and measurable. The cycle stage indicator is offered as a hidden variable. The proposed algorithm was applied to analyze and forecast the cycle development of Ukrainian economy.

Keywords. Socio-economic system, cyclic dynamics, forecast, algorithm, hidden markov model.

1. Introduction

To forecast cyclic dynamics of socio-economic systems most scientists traditionally use time series decomposition, spectral analysis, ARIMA-models [1, 2]. However, hidden markov model can be applied effectively to achieve the same goals.

Hidden markov model consists of two types of variables: unobservable hidden variable and variable, which is observable and measurable. We suggest interpreting the cycle stage as hidden variable. We can only determine the type of "cycle stage" indicator indirectly using set of observed and measurable socio-economic indicators.

The goal of this research is to suggest the cyclic development forecasting algorithm based on hidden markov chains theory. The object of the research is macro level socio-economic systems.

2. Research Set Up

The following assumptions were applied within the research.

The state of a socio- economic system in the period t is defined as a vector

$$S_t = (C_t, x_{t1}, x_{t2}, ..., x_{tm}),$$

C_t - - the value of "cycle stage" indicator, x_{tj} - the value of the j-th measurable socio-economic indicator, $j = [1,m]$, $t = [1,T]$.

The number of possible states of the system is countable. That is why the analyzed stochastic process may be determined as process with countable state space. The given set of states may be classified on homogenous groups. Each group represents a particular stage of a cycle. We assume that a cycle consists of four stages. These stages are peak, recession, trough and expansion. The stages of any cycle, as a rule, follow each other in a particular sequence.

Thus, the occurrence of a future stage depends only on the immediately preceding one. This means that such process may be described as Markov process. The process of changing stages isn't observable for the researcher. It is only possible to determine the type of a cycle stage indirectly by assessing values of observable and measurable indicators of socio-economic development. Thus, hidden markov model may be used to forecast the stages of a cycle.

Hidden markov model is determined as follows[3,4]:

$$\lambda = (P, B, w),$$

$P = \{p_{ij}\}_{L \times L}$, $i, j = [1, L]$ - type of the stage transition probability distribution,

L- number of stages;

$B = \{b_j(k)\}$, $j = [1, L]$, $k = [1, M]$, - observed variable probability distribution,

$b_j(k)$ - probability of k-th value of observed variable for stage j,

M - number of unique values of observed variable,

$w = (w_1, w_2, ..., w_L)$ - initial probability distribution.

The cyclic development analysis and forecasting algorithm consists of two blocks: cyclic development analysis and cyclic development forecasting. Let's consider blocks of the algorithm.

Block of analysis includes the following steps:

- constructing the initial set of socio-economic observable and measurable indicators that describe the cyclic development;
- describing and classifying cycle stages;
- estimating transition probabilities for cycle stages;
- estimating initial probability distribution;
- determining the measurable and observable indicator which should participate in hidden markov model;
- estimating observable variable probability distribution.

Block of forecasting includes the following steps:

- forecasting measurable and observable indicator and forming a sequence $O = \{O_1, O_2, ..., O_t, ..., O_T\}$ of observations;
- forecasting the optimal sequence of stages Q that maximize the probability $P(Q | O, \lambda)$.

3. Calculation

The proposed algorithm was applied to analyze and forecast the cycle development of Ukrainian economy. Let's discuss the obtained results.

The initial set of socio-economic observable and measurable indicators that describe the cyclic development was formed as the matrix:

$X = \{x_{tj}\}_{T \times m}$ - the value of the j-th measurable socio-economic indicator in the period t, $j = [1, m]$, $t = [1, T]$.

The following indicators were included into the model:

- Retail trade turnover;
- Average monthly wages and salaries per employee;
- Export of goods and services;
- Imports of goods and services;
- Capital investment;
- Volume of construction works;
- Money supply M3;
- Refinance rate;
- Natural population movement.

To eliminate differences in units of measurement all series are given as growth rates.

The initial set included monthly data $X = (X_1, X_2, ...X_t, ..., X_T)$. The set was divided on four classes $S = \{S_1, S_2, S_3, S_4\}$, where S_2 - recovery stage, S_3 - recession stage, S_1 - depression stage, S_4 - stagnation stage. The cluster analysis procedures were used to determine the classes. These procedures groups objects as so objects within a group (class) is similar to one another and different from the objects in other groups (classes). In this research we used k-means clustering. The key advantage of this procedure is that it allows to determine the number of groups beforehand.

The results of estimating transition probabilities are presented in the table 1.

Table 1. Transition probabilities

	S1	S2	S3	S4
S1	0,846	0,000	0,154	0,000
S2	0,000	0,846	0,154	0,000
S3	0,023	0,023	0,931	0,023
S4	0,000	0,000	0,083	0,917

The vector of initial probabilities associates with January, 2016. Taking into account the fact that 2015 year was determined as depression stage, the vector of initial probabilities is taken from the second string of the table 1:

$$w = (0{,}846; 0{,}000; 0{,}154; 0{,}000).$$

The measurable and observable indicator X^c which should participate in hidden markov model may be determined in two ways:

- it is taken from the set X, that was determined on the previous step: $X^c \in X$, $X = \{X_1, X_2, ..., X_m\}$;
- it is not taken from the set X : $X^c \notin X$, $X = \{X_1, X_2, ..., X_m\}$.

Within this research we have applied more than one measurable and observable indicator. All indicators except the first one were taken from the initial set X. These indicators are:

- Industrial production index;
- Retail trade turnover;
- Average monthly wages and salaries per employee;

- Export of goods and services;
- Volume of construction works;
- Money supply M3.

The retrospective discrete series for all observable indicators were modified into interval series. As a result, the dimension of each matrix B was reduced significantly.

The hidden markov model $\lambda_{pr} = (P, B_{pr}, w)$ for measurable and observable indicator of industrial production index is presented below:

$$P = \begin{matrix} 0{,}846 & 0 & 0{,}154 & 0 \\ 0 & 0{,}846 & 0{,}154 & 0 \\ 0{,}023 & 0{,}023 & 0{,}931 & 0{,}023 \\ 0 & 0 & 0{,}083 & 0{,}917 \end{matrix} \qquad B_{pr} = \begin{matrix} 0{,}92 & 0{,}08 & 0 \\ 0 & 0{,}92 & 0{,}08 \\ 0 & 0{,}47 & 0{,}53 \\ 0{,}08 & 0{,}17 & 0{,}75 \end{matrix}$$

$$w = (0{,}846; 0{,}000; 0{,}154; 0{,}000).$$

Eventually, six hidden markov models were formed. These models have common transition matrix and vector of initial probabilities and different matrixes B.

Viterbi algorithm was applied for each model to determine the optimal sequence of stages for period feb-dec 2016. Final forecast was formed as a composition of all six forecasts.

4. Conclusion

The obtained results have shown the depression stage during the forecasting period. The accuracy of the assessment increases thanks for using several models based on different observed variables. The modeling results correspond with real situation, observed during 2016 year. Such coincidence may be used as an argument in favor of the proposed algorithm. The future research directions should take into account a possibility of changing the values of transition matrix during the forecasting period.

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Neural Fuzzy Models of Estimation of the Financial Condition of Corporate Systems

Tamara Klebanova, Lidiya Guryanova, Vitalii Gvozdytskyi

S. Kuznets KNUE, Nauki ave., 9a, Kharkiv, Ukraine
t_kleb@ukr.net, g_lika@list.ru, gvozdikramm@gmail.com

Abstract. The article is devoted to the problem of assessing the financial condition of corporate systems. For this purpose, models of estimation of the threat of forming financial crises in corporate systems are developed on the basis of method of neural networks and fuzzy logic. The realization of neural fuzzy models was approbated in Ukrainian agricultural corporations.

Keywords: analysis, bankruptcy, crisis, estimation, neural fuzzy model.

1. Introduction

Under market economy conditions one of the most important problems is a problem of preventing the forming of financial crises on enterprises and therefore of preventing insolvency and bankruptcy as an extreme degree of crisis. A large number of cases of bankruptcy and enterprises' liquidation is carried out every year in Ukraine. In addition, approximately every second domestic company operates at a loss and is in a financial crisis that could lead to their bankruptcy in the future. Such enterprises are in each region, both small businesses and large corporations become bankrupt. Now more than 50% of Ukrainian economy consists of corporate type enterprises, moreover, there is an exact tendency of incorporation of small businesses by large enterprises which are the part of corporations. So, for modern economy of Ukraine the problem of corporate bankruptcies is of considerable interest. That is why implementation of modern technologies of economic and mathematical modelling into domestic corporate systems for timely threat assessments of crisis forming and for its prevention is of particular importance.

2. Analysis of recent researches

The development of such models of estimation of the threat of bankruptcy and researches about general problems of crisis management were started only in the second half of the 20th century. The works of domestic and foreign scientists are devoted to these issues such as works of E. Altman, V. Beaver, V. Vitlynskyi, V. Zabrodskyi, Y. Zaichenko, G. Kadykov, A. Matviychuk, A. Morozevich, A. Nedosekin, D. Olhson, R. Sayfulin, G. Springate, M. Suvorov, R. Taffler, A. Tereshchenko, D. Chesser, etc. In particular, such aspects of bankruptcy problem were investigated, as the choice of the most significant factors affecting the probability of bankruptcy, an analysis of the most appropriate methods of estimation of the threat crises forming in enterprises, different approaches to anti-crisis policy of enterprises, implementation of econometric modelling into the process of financial analysis, dynamic assessment of financial stability of different entities depending on various external and internal factors and so on.

But these works paid less attention to assessing the impact of financial crisis at

subsidiaries on bankruptcy of the corporations at the whole. In addition, the most current models of estimation of bankruptcy threat are the models of "pattern recognition", i.e. they definitely characterize enterprise's financial condition to an exact class of crisis. But companies are often in transition from one phase of crisis to another, and it is impossible to accurately describe his financial condition. Also still unresolved problem is the possibility of using such models for corporate enterprises of all sizes and of various industries; as well, currently not enough attention is paid to the development and making of
anti-crisis management decisions and to the assessment of their effectiveness in these enterprises [3, 6-7, 9].

The goal of this study is to develop economic and mathematical models of estimation the financial condition of corporate systems based on neural fuzzy approach. To achieve this goal, it's needed to perform a number of tasks:

- to explore and to analyze the results of current domestic and foreign researches according to the chosen themes;
- to develop the model of estimation of the threat of financial crises forming in corporate systems based on hybrid neural networks and fuzzy logic mathematical tools;
- to test built models and to perform their approbation on domestic corporations.

3. Methodical approach to the estimation of crises threat in corporate systems

The financial system of any enterprise of corporate type has a subsystem of crisis management. In modern conditions of uncertainty and risks the task of crisis management is not only about prevention the crisis, but also about the early indication of this bifurcation point, about forecasting, which would prevent irreversible negative changes and about reaching a new level of development with minimal negative effects. So, now the main focus of modern improvements in corporate crisis management system is management based on proactive technology [1].

With technological, innovative progress in recent years, more attention is paid to methods of artificial intelligence. Thus, using developed software packages recently researchers use neural networks for crises threat assessment in enterprises, the accuracy of which is higher than of other methods [2, 7, 10]. And, regarding the results of previous studies [4-6], we can conclude that in the present conditions of uncertainty and risks as a tool for modelling the estimation of the threat of financial crises forming for corporations it would be best to use a method based on the use of neural networks and mathematical fuzzy logic. Because this method combines the most positive signs used in other methods and its application coincides with the essence of the implementation of proactive crisis management in the corporation.

But in corporate systems for estimating the crises threat there should be implemented a new, improved approach which, considering the elimination of detected shortcomings in the above analysis, must be based on a synthesis of economic and mathematical models of estimation the crises threat in corporate management systems. Implementing this approach will allow to diagnose the possibility of financial crisis in the particular company (subsidiary) and in the corporation at whole, to determine crisis' depth, and to develop and to make appropriate crisis management decisions.

This approach was proposed in studies [5-6] and consists of 5 modules: 1) analysis of the current financial condition of the corporation; 2) analysis of current financial condition of subsidiaries; 3) assessment of the impact of financial crisis on the subsidiary to the threat of bankruptcy of the corporation; 4) Forecasting the threat of crisis; 5) crisis management.

In the proposed approach there are such used methods as econometric methods, complex of methods of decision theory and modern economic and mathematical methods, such as neural fuzzy modelling and forecasting method "caterpillar". Its use will allow implementing the technology of proactive crisis management in the activities of corporations, analyzing the financial condition of both the subsidiary and the entire corporation adequately, assessing the impact of financial crisis on the subsidiaries to the threat of bankruptcy of the whole organization and implementing the necessary range of measures for its prevention.

4. Neural fuzzy models of assessment of the financial condition of corporate enterprises

Developed in accordance with this proposed approach model basis of estimation of the threat of financial crises forming in corporate systems was tested on the example of domestic agricultural corporations. According to the algorithms of neuro-fuzzy networks [10] for building the models of estimation of crisis threat in the head office of the corporation (realization of module 1) training sample was used which consists of 36 non-governmental head enterprises of corporations of agricultural sector of Ukraine, among which there are 12 of them that became bankrupt, and 24 normal functioning corporations.

According to the structure of the model it was used the following system indicators as an information space, forming and justification of which was carried out in previous studies [8]:

X1 - coefficient of suitability of fixed assets;

X2 – coefficient of quick liquidity;

X3 - coefficient of financial autonomy;

X4 - asset turnover ratio;

X5 - profitability of activity.

Formed system of indicators characterizes the financial condition of the corporation from the point of view of all areas of its activity, so it allows to estimate it adequately.

As a result, variable Y in the neuro-fuzzy model value of the threat of financial crisis forming is taken. And in the training sample Y acquired two values: 1 - if the company became insolvent, and 0 - if it is not bankrupt. To classify the values of Y obtained as a result of the implementation of this model, cluster analysis was conducted. The effectiveness of partitioning of the scale of Y values into 3, 4, 5 and 6 clusters was compared by the method of k-means. Number of classified objects in each cluster for all variants and appropriate values of total variance within groups are presented in Table 1.

The development of neuro-fuzzy model of the threat of financial crisis forming on the main enterprise of corporation was conducted in MatLab program. Model's input parameters are five selected indicators X1-X5, the output parameter is a resulting variable Y.

The structure of the fuzzy inference system (FIS) was generated in the program by selected type (Sugeno). The results of analysis of previous studies [6] showed that for achieving the best results of model development (for getting the slightest error) by the method of selection number number of specified linguistic terms (for all 5 inputs) and type of membership functions were chosen. Thus, there were set 3 linguistic terms for each input variable X1-X5; the triangular type was chosen as the type of membership functions. The rules of fuzzy productions were formed automatically by the program; Each fuzzy rule has been checked for logical and theoretical economic content and for the lack of controversy. So, all generated rules were proved to be adequate, and there is no need for their editing.

Table 1. Partitioning of Y values into clusters

Characteristic	Partitioning into			
	3 clusters	4 clusters	5 clusters	6 clusters
The number of objects in clusters	cluster 1 – 5 objects cluster 2 – 13 objects cluster 3 – 59 objects	cluster 1 – 5 objects cluster 2 – 12 objects cluster 3 – 10 objects cluster 4 – 50 objects	cluster 1 – 4 objects cluster 2 – 4 objects cluster 3 – 10 objects cluster 4 – 32 objects cluster 5 – 27 objects	cluster 1 – 10 objects cluster 2 – 4 objects cluster 3 – 1 objects cluster 4 – 3 objects cluster 5 – 32 objects cluster 6 – 27 objects
The value of total variance within group	47,39	43,36	41,23	43,20

Thus, by the criterion of minimization of total variance within group the best conducted partitioning is done into 5 clusters. Thus, formed scale of interpretation of Y values is presented in Table 2.

Table 2. Interpretation of Y values

Y value	Threat of crises forming
$Y \le 0$	Very low
$Y \in (0;0.25]$	Low
$Y \in (0.25;0.75]$	Medium
$Y \in (0.75;1)$	High
$Y \ge 1$	Very high

Thus, the structure of the generated Sugeno fuzzy inference system has the following form: it contains 5 input variables (input1 = X1-input5 = X5), 15 terms of input variables (3 terms for each input), 243 fuzzy rules, 1 output variable Y, 243 therms of output. To carry out the process of learning of the hybrid network the following steps were held:

1. Selection of a hybrid learning method of a hybrid network that is a combination of the method of least squares and of the method of reduction of reverse gradient.

2. Setting the level of training error (Error Tolerance) - value 0 (as by default).

3. Setting the number of cycles (Epochs) - value 40 (by default - 3).

Thus, we can say about the high adequacy of built neuro-fuzzy model (error - less than 0.11%).

Testing of built neuro-fuzzy system, which was conducted using Matlab program, showed that as the result neural network adequately built the system: by testing results the average error is equal to 0.10985%, errors values depend only on the first six cycles, after which they all are equal to about 0.0011. Thus, the built model can and should be used in future research.

Built neuro-fuzzy model was used to assess the financial condition of agricultural corporation "Biscuit-Chocolate", which is the largest producer of confectionery in Kharkov region and is part of the top 5 producers in Ukraine. The corporation includes 5 subsidiaries, which provide all the basic technological stages of production. The significance of this corporation for Ukraine's economy is underlined by the fact that it employs more than 3,000 workers, and that 30% of corporation sales is accounted for export.

So, it was determined that at the time of the study (01/01/2015) the value of resulting variable Y (value of the crisis threat) for the corporation is -0.541, i.e. the probability of bankruptcy for this company in the near future is very low.

Likewise, Y values for the corporation "Biscuit-Chocolate" were calculated for years 2002-2015. The dynamics of changing the values of the threat of financial crises forming in the corporation is shown on Fig. 1.

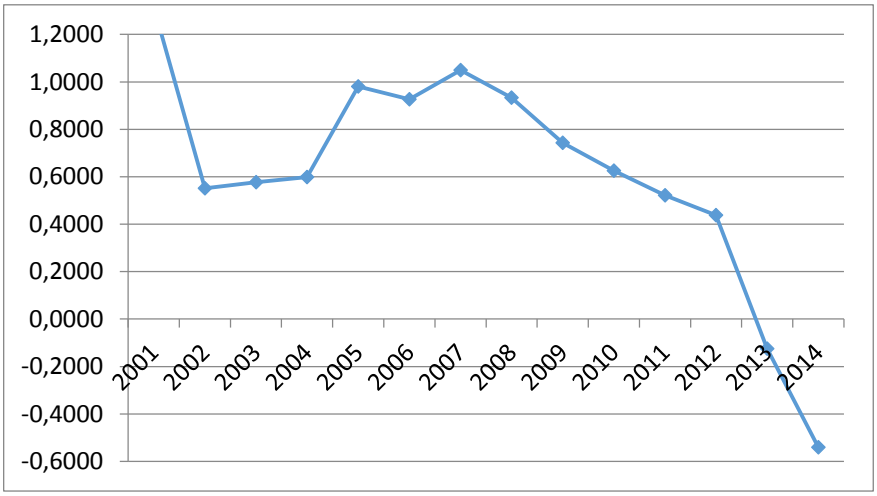

Fig. 1. The dynamics of Y values

As can be seen on Fig. 1, in general, for analyzed period the trend of decreasing of Y value of crises threat is noticeable, i.e., using a scale of interpretation of values of crisis threat (Table 2), we can conclude that there is a tendency of improvement of the financial condition of the corporation. In general, it can be concluded that the results of implementation of developed model of the estimation of fthe threat of financial crises forming on the example of the corporation "Biscuit-Chocolate" adequately describe the financial condition of the corporation throughout the period analyzed.

However, the functioning of such complex financial and industrial systems, as a corporation, is explained by many factors, among which the most important is the financial condition of subsidiaries, because the corporation well-being depends exactly on their activity. Therefore, despite the fact that the results of modelling the probability of bankruptcy of the corporation "Biscuit-Chocolate" is very low, it is advisable to assess the threat of financial crises forming on subsidiaries, as the crisis on these enterprises can lead to catastrophic consequences in the whole organization in the future. That must implement module 2 of proposed approach.

The model of estimation of the threat of financial crises forming on subsidiaries (module 2) was built on a sample of 40 non-government subsidiaries of Ukrainian agricultural sector, and among them 24 are normally operating companies and 16 – which had become

bankrupt. As while developing the neuro-fuzzy model in module 1, the same information space of 5 indicators was used. To generate fuzzy inference system, unlike the first model, trapezoidal membership function of input factors and linear input type membership function of output variable Y were used. Testing of neuro-fuzzy model showed high adequacy of constructed system, because of low level of error model made (0.00115%).

This model was approbated on 5 subsidiaries of the corporation "Biscuit-Chocolate": Enterprise "Kharkiv biscuit factory", "Kharkovchanka", "Agricultural Firm named after G.S. Skovoroda"," Pervuhinskyy sugar plant"and "Sloboda". It should be noted that first two enterprises produce and sell prepared pastries, and the latter - provide the necessary raw materials to them.

The dynamics of the values of estimation of crises threat on corporation's subsidiaries is presented on Fig. 2.

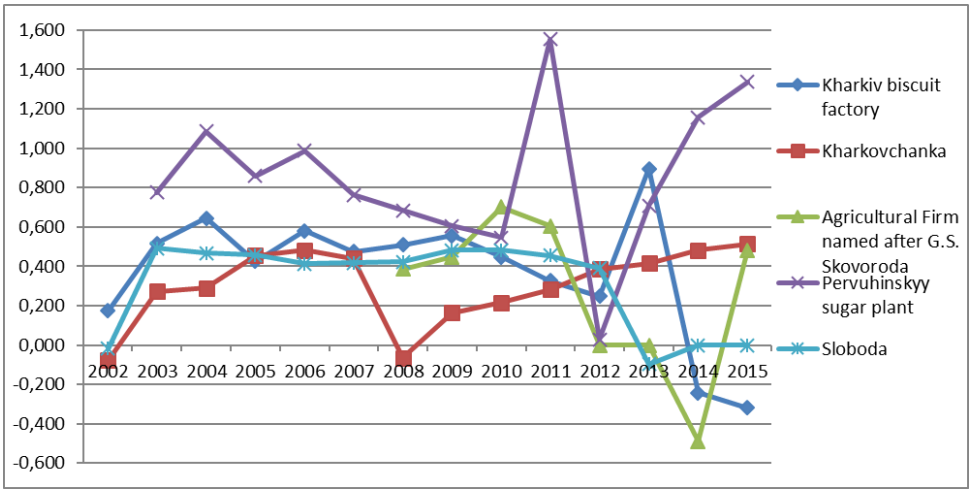

Fig. 2. Dynamics of the values of estimation of crises threat on corporation's subsidiaries

As can be seen on Fig. 2, during last 14 years financial position of these subsidiaries has different trends. Using the scale of interpretation of Y values (Table 2), we can conclude that the average threat of the crisis is at the enterprise "Kharkovchanka" (and it remains at this level since 2008, with a gradual deterioration) and at "Agricultural Firm named after G.S. Skovoroda "(and last year the threat increased significantly: from very low to high). At the moment very low threat of the financial crisis is at "Kharkiv Biscuit Factory" and at "Sloboda", and in the last 3 years there is a noticeable trend of improvement of their condition in the future.

The worst condition is at "Pervuhinskyy sugar factory", where the financial crisis could go to a catastrophic phase - bankruptcy; moreover, for the last 3 years, the value of the threat was only increasing. Therefore, the corporation management should pay the greatest attention to financial processes on this subsidiary, which provides sugar to two major corporate revenue factories.

Besides the verification of the adequacy of application results of built neuro-fuzzy models by the criterion of minimizing errors, also their adequacy was proved by the analysis of financial activity of subsidiaries and of the whole organization. For example, as can be seen on Fig. 1, in 2008 there was a significant "leap" of Y value, and the threat of crisis in the corporation was very high. And this is proved by relevant processes proceeded in the

corporation during this period: a significant increase in accounts receivable without income growth, reducing of net income and of corporation's sales revenue, the accounts payable (especially, current) almost doubled, increasing operating costs by 50% etc. But that year the management implemented a complex of measures to leveling the crisis, which led to a significant improvement in the financial condition of the corporation.

Thus, according to the results of modelling we can conclude that the current financial condition of the corporation "Biscuit-Chocolate" is characterized by a very low risk of forming of the crisis, but on some of the subsidiaries of the corporation, there is even a significant threat of bankruptcy, i.e. the corporation already has serious threats of reduction of the solvency and of more acute crisis situations that can lead to catastrophic consequences for the entire corporation in the future. Therefore, it is expedient to realize the modules of crisis forecasting at subsidiaries and at corporation and to implement a complex of anti-crisis measures.

5. Conclusion

The review clearly shows the necessity of development the methods of estimation the threat of financial crises forming in corporate systems. Developed by using the methods of fuzzy logic and neural network models of estimation the financial condition of corporate systems allow, using fuzzy rules to determine the crises threat at head enterprise of the corporation and at its subsidiaries not only in the current but in the subsequent period as well, allowing the company to timely detect and prevent threat to the financial crisis and to implement a complex of anti-crisis measures.

That is why it can be considered as a promising area for future research.

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Protection Technologes for Paper Currency (Banknotes)

Sergii Kavun, Marina Pashkevich, Alina Zamula

Kharkiv Educational and Scientific Institute, University of Banking, Kharkiv, Ukraine
kavserg@gmail.com, masja7011@yandex.ru, zamula.alina@gmail.com

Abstract: Paper currency protection mechanisms are analysed and structured in the article for further ranking and identifying the most important protection technique. The categories "paper currency", "paper currency protection", "banknote", "banknotes protection", "fake banknote" are researched using Internet analysis method. The problem of currency protection choosing is interpreted with the usage of graph theory. Mathematical interpretation of optimal currency protection model with the help of the generated classification was developed.

Keywords: paper currency, banknote, banknote protection, paper currency protection, false banknote.

1. Introduction

The exact date of the first paper money appearance still remains unknown. Paper money motherland is China, where the first paper was invented. Money is one of the most important inventions of humanity. Since they are - an integral and essential part of the financial system in each country [3]. Changing the amount of money in turnover can significantly affect on the income, price, and output level [4].

There are two main concepts of the money origin in economics theory [7]: the rationalist theory - the money appeared as a result of a rational agreement between the people because of the need of allocation of the specific tool for the sphere of trade turnover servicing; the evolution theory - the money is allocated from the general good mass, as they are very convenient for the functional role performing of money good. One or another good becomes money only in case of certain social form, goods production and turnover.

One of the main causes of the paper banknotes appearing are: - the need for long-term storage and the units durability; - Ease of paper money using; - The property of paper money be divided into parts, their components with a lower value (although some currencies has not derivatives of paper money, for example, the national currency of Vanuatu - vatu [8]; - the shortage of the metal connected with the mining area development, which the coins are done from, - the speed of production and interchangeability the threadbare paper money for new ones.

Thus, these and other reasons have caused the need of the currency introduction into the economy of many countries in the world (as a rule, the central banks of different countries introduced the currency). These formed the monetary system of the countries. Paper money always has the appearance, which demanded permanent changes caused by economics needs, design trends, the need of strengthening their defense, and others. Along with the production technologies, development (emission) of the banknotes developed the technique of forgery too. At the same time, manufacturers have tried to improve the protection of paper currency due to the introduction of different degrees of protection.

In course of time, people have learned to forge money, and therefore monitoring and performance data management could be lost or the figures were not accurate. Along with the

development of paper money production technologies their forgery mechanism developing. Therefore, manufacturers have tried to improve the paper money protection through the different types of protection introduction.

The banknote and its fake can be compared by analogy with the virus and antivirus. Nevertheless, you can trace that this comparison has mutually opposite direction. That is, first appears banknote, after it appears a copy (fake). However, the virus and the antivirus can be seen opposite phenomenon: the firstly, virus appears, and then begins antivirus development to eliminate the danger.

Since the first fake money appeared, experts wanted to know in what ways they are better to protected. Experts improved their skills, what led to the different ways of protecting paper money appearance (reason of choosing paper banknotes based on low complication of their forgery), which became more difficult to forge. Eventually, developers and designers of paper money (banknotes) begin to compare the achievements results, providing the best protection, what led to the development of the most protected banknotes, which have the most practical design. This is what paved the way to a detailed study of the mechanisms and approaches that without the development of a mathematical model is impossible to derive the formula "the best banknote".

Of course, all different mathematical models [22] are different, because everyone thinks its calculating method is rational. Analysis of available sources showed that scientists have not yet come to a single mathematical model of calculation, so there are a few examples of calculations used by modern scholars [1; 2, p. 39; 3]. Perhaps, the models are not optimal to solve the paper currency protection problem. Whereas considered not a complete set of parameters and characteristics (do not have single parameters) are very difficult to choose the most important elements because when this elements combined together, these elements form a single set, which is full protection for the banknotes.

Innovative model was developed using mathematical tools that were offered to use to determine the best banknote by level of the protection degree. There was developed this model to consider each element and its using of each learnt by us. This will make an analysis based on our model and discover the best of chosen currency.

The authors based on the Internet-analysis - method, the purpose of which is to obtain a valuation of the selected categories [21], have carried out research and analysis of the paper money using relevance connected with paper money and their protection. These categories are "paper currency", "paper currency protection", "banknote", " banknote protection ", "fake banknote". Based on these estimates [20] will be possible to conclude the further researches feasibility and the selected categories relevance in the range of 1990 - 2015. Also to evaluate the impact of economic, political and social factors on the selected category. This mechanism was also used to analyze the classification of protection mechanisms (Item 3).

2. Historical facts

Unlike monetary metals that retain value even after thousands of years in every country, the paper money itself has no value. Paper money course is guaranteed by the government or by the bank issuing them, so the political and economic crises can quickly devalue them. However, despite some shortcomings, the value function measure of the paper money is performed as well as the metal and in role of turnover and payment much easier.

Banknote (from the English banknote - "bank bill") - a money sign made of paper or plastic, which is issued by the central bank and required to accept on the government territory.

In the 600 years in China were printed local paper money. To 960 year, Song Dynasty because of the copper lack for coinage issued for general turnover in the country. The banknote was a document confirming the exchanging possibility for another valuable object, usually a

coin. This fact notified the European Venetian traveler Marco Polo, who visited Beijing in 1286, however, in Europe; paper money issue began to practice only in the XV century, when Johannes Gutenberg invented the printing press.

The original banknotes were geographically and in duration limited. If a banknote is presented later claimed term, it cost less than the nominal value. Nevertheless, the Mongol Yuan dynasty, faced with a huge specie shortage to fund the China occupation, carried out in 1280, begun printed paper money without restrictions on time.

It should be noted that along with the obvious advantages (relative ease of manufacture, compact size) paper money have significant drawbacks, too. They were prone to depreciation, and easier yielded to forgery. Therefore, from the beginning of its existence, the paper money supplied with different degrees of protection, by the presence of which the banknote could be determined as authenticity.

The first banknote protection method was watermark. The first watermark appeared in Bologna (Italy) in 1282 or 1283 [1]. Paper manufacturers apply them then and later to identify their product, and also on postage stamps, banknotes, and other government documents to protect against forgery. Subsequently, the development of paper money around the world began to introduce new paper money protection methods.

Today, banknotes in most countries have a large number of protection mechanisms. The study of sources has shown that these mechanisms are not systematized. Therefore, appropriate to continue the investigation of banknotes and their protection mechanisms.

3. Categories research using the Internet analysis method

The use of the Internet-analysis method [25] is based on query language with its specific character, while all search engines support this language. The results of this method are the averages of the results from a variety of selected search engines during definite time interval. Thus, the research dynamic provides. There are many search engines including: Google, Yandex, Yahoo, I.UA, Mail, Alltheweb, Rambler, Bing, Meta, Nigma, Metabot, AltaVista, Wikipedia, UaPORT, Uaportal, Holms, Poshuk, Weblist, List, Lycos, UP, Infoseek, Magellan, Galaxy, Webcrawler, Dmoz, Jayde, Asiannet, REX, Euroseek, Search.MSN, Whatuseek. This set is sufficient to obtain a sample of the results, which is the representative [1].

The research results are displayed on graphics shown in Fig. 1 - 5. All datas were normalized and reduced to a single measurement scale.

Fig. 1 shows a positive linear dynamics relevance change of the term "paper currency". The relevance of the term refers the (or occurrence frequency) mentioned term information quantity obtained by the Internet analysis method as a number of references issued by the search engine.

There is the graphic displayed on the Fig. 1 shows the distribution of the relevance dynamics for the "paper currency" term. The general trend of the graphic is positive (the growth rate is 7.58%). There is also a sharp relevance increasing of this category in 2000 (20.45% compared to 1999), 2003 (6.82% compared to 2002), 2007 (12.88% compared to 2006) shown on this graphic.

The sharp relevance increasing in 2000 can be explained by the fact that Ukraine has been through an economic growth wave, the first signs of which were planned in the last quarter of 1999. By the results of 2000 year the industrial production volume increased by 12.4%. GNP is one of the factors that influenced the growth relevance and reached a value of 5.9%. In 2003 year, significant growth dynamics could be observed due to the issue of money, when the new twenty Hryvnia bills were released [2]. There is in 2007 year also is positive trend, it is due to the new banknotes issuing denominations of one, ten, two hundred and five hundred Hryvnia, also partially was changed their design [2].

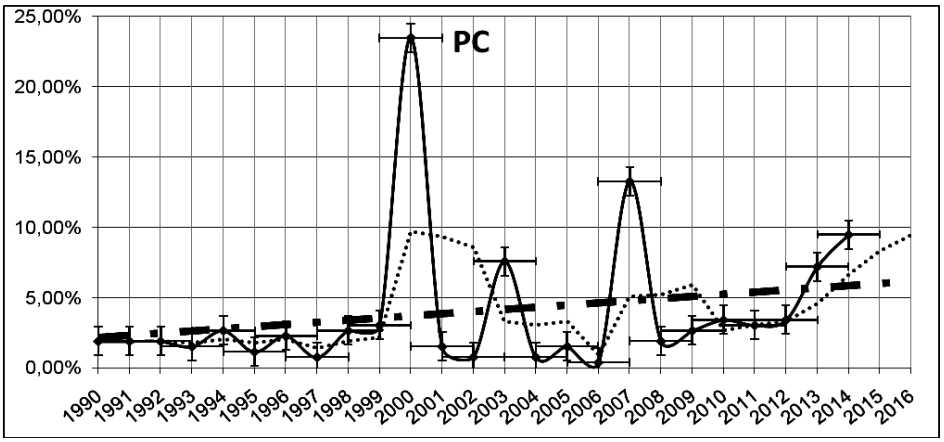

Fig. 1. The graphic of dynamics relevance change of the term «paper currency»: dotted line – the forecast based on the linear filtering; dotted point line – the linear trend shows a general trend.

There was calculated the forecast based on linear approximation equation for obtained distribution, this information is presented in Table 1.

Fig. 2 shows a graph of the relevance dynamics distribution for the "paper currency protection" term. The general trend of the graph is positive (the growth rate is 18.12%). The sharp relevance increasing in 2000 (13.22% compared to 1999), 2010 (8.37% compared to 2001, where the slower dynamics growth obtained up to 2010), 2012 (21.9% compared to 2011), 2014 (9.81% compared to 2013 year). The sharp relevance increasing in 2000 year was caused due to the sharp economic growth, which was mentioned in the first research.

The positive dynamics in 2010 was observed due to the two hundred bills forgery increasing, according to the National Bank of Ukraine: "The National Bank of Ukraine said that fron the beginning of 2011 the amount of withdrawn from circulation forgery bills decreased by 34% compared to the same period in 2010," [2]. There is in 2012 were held analytical researches by National Banks of some countries: Ukraine, Russia, EU countries, researches conducted in Ukraine, showed that in 2012 the number of forgery bills on one million hryvnia banknotes was 4.1 pieces. There is in 2015 was introduced a bill denomination of one hundred hryvnia sample of 2014 with improved protection system [2].

If we take the period 2001 - 2009, the periods after a sharp rise until the next actuality jump, we can see that there is a positive dynamics, which approximately is 3%. This can be connected with the not very great interest increasing to this area during the period.

Investigation of the period 2000 - 2012 showed that the overall trend growth was 13.01% (the sharp increasing observed in 2010), what was due to the stable development of the economy during this period.

There was calculated the forecast based on linear approximation equation for obtained distribution, this information is presented in Table 1.

Fig. 3 shows a graph of the relevance dynamics distribution for the "banknote" term. The general trend of the graph is negative. The sharp relevance increasing in 2000 (913,5% compared to 1999), there are not another increasing. Basically, the trend varies from 0.65% to 5.74%. Interest of the category was slightly lower than 2014, it is 62.43% in the 1990 year.

We also note that in 1999 interest to a sharp jump was higher than after a sharp interest rise to this category (the difference is 17.5%).

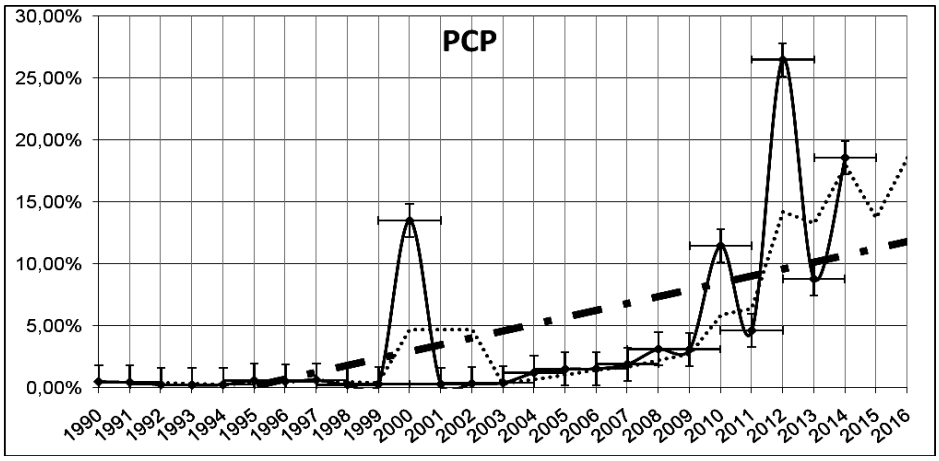

Fig. 2. The graphic of dynamics relevance change of the term «paper currency protection»: dotted line – the forecast based on the linear filtering; dotted point line – the linear trend shows a general trend.

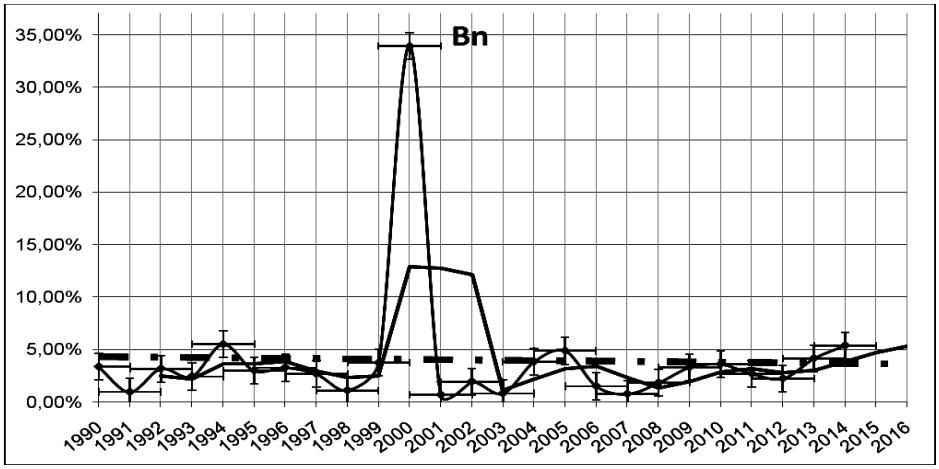

Fig. 3. The graphic of dynamics relevance change of the term «banknote»: dotted line - the forecast based on the linear filtering; dotted point line - the linear trend shows a general trend

The sharp relevance increasing in 2000 can be explained by the fact that Ukraine has experienced a wave of economic growth, the first signs of which were planned in the last quarter of 1999 (it has been said in previous studies). By results of 2000 the volume of industrial production increased by 12.4%. This fact influenced the growth of GNP and reached a value of 5.9%.

There was calculated the forecast based on linear approximation equation for obtained distribution, this information is presented in Table 1.

Fig. 4 shows a graph of the relevance dynamics distribution for the "banknote protection" term. The general trend of the graph is negative. The sharp relevance increasing in 2000 again (175% compared to 1999). Also mentioned 5 points, the relevance of which is equal to 0%. Perhaps this was due to the fact that in these periods have not been developed

and implemented new security mechanisms. The sharp relevance increasing in 2000 was due to the sharp economic growth, which was described in previous researches. If we take the period 1990 - 2000 and 2000 - 2010, the periods before and after a sharp rise, we can see that the average dynamics before relevance jump is 5.53%, and after - 4.48%. This may be due to the fact that many security methods were formed and implemented until 2000, and after the peak of their activity this methods only improved and the interest fell down.

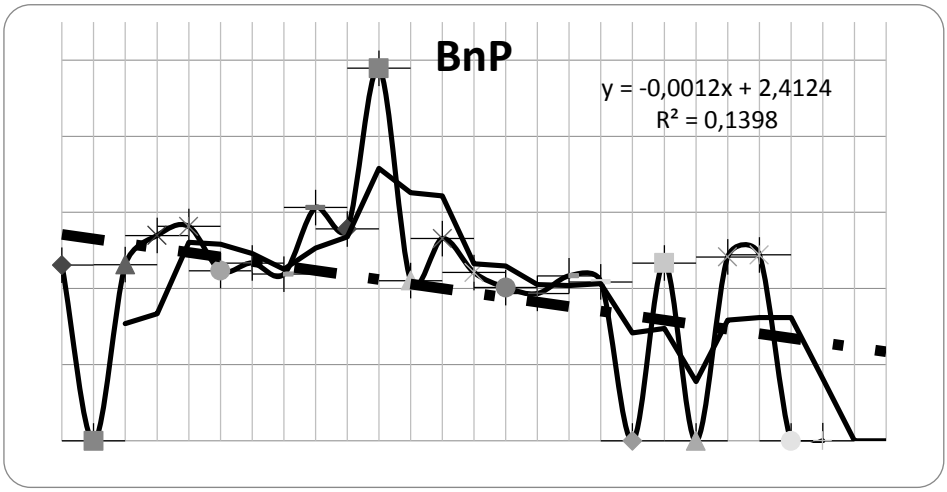

Fig. 4. The graphic of dynamics relevance change of the term «banknote protection»: dotted line – the forecast based on the linear filtering; dotted point line – the linear trend shows a general trend.

There was calculated the forecast based on linear approximation equation for obtained distribution, this information is presented in Table 1.

Fig. 5 shows a linear and negative dynamics of the relevance changing for the "false banknote" term (fig. 5 shows a graph of the relevance dynamics distribution for the "false banknote" term). The general trend of the graph is negative and is equal to 0,19%. There is not any relevance sharp on the graph. The relevance of this category only falls down, two points have even zero relevance, and one - is 0.01%. The maximum value on the graph is 5.18%. Until 1998, the urgency was unaltered and 5.17%, in 1999 has value 5.18%, i.e. 0.01% rising. Before relevance sharp trend was equal to 5.02%, followed sharp decline in 2006 to 0% (no wonder, because 2006 year, experts consider this year when it was noticed one of the largest amount of forgery bills in Ukraine), but in 2007 the urgency rose again up to 5.02%. The next sharp decline period was in 2012 and valued to 0.14% (compared to 2011 decreased by 3585%). According to the National Bank of Ukraine in 2012 by 1 million bills had about 4.1 unit's forgeries, in 2013 - 3.5 forgeries, in 2014 - 3 forgeries. That is, we see that the trend of forgeries fairly low, respectively, and interest during these years.

There was calculated the forecast based on linear approximation equation for obtained distribution, this information is presented in Table 1.

Thus, research analysis confirm the relevance of selected categories, indicating the feasibility research, as well as the need for further researches and new methods development and approaches in the area related to paper currency and its protection. That is why we would like to introduce the paper currency protection mechanisms classification discussed in the next section.

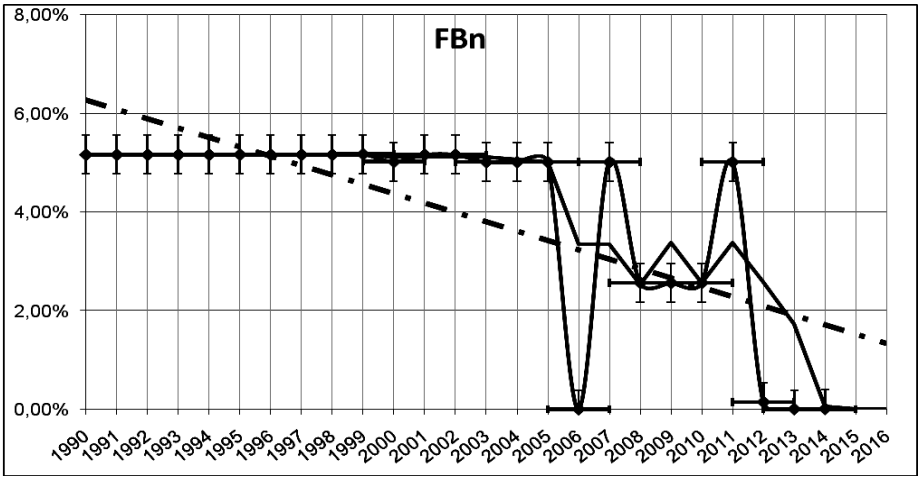

Fig. 5. The graphic of dynamics relevance change of the term «false banknote»: dotted line - the forecast based on the linear filtering; dotted point line - the linear trend shows a general trend.

Table 1. The aggregated table of results

Abbreviation	The equation of linear trend	Number of figure	R^2	Accuracy
PC	y = 0,0016x - 3,0692	1	0,0507	forecast accuracy does not guaranteed
PCP	y = 0,0056x - 11,133	2	0,3725	forecast accuracy does not guaranteed
Bn	y = -0,0003x + 0,5611	3	0,0009	forecast accuracy does not guaranteed
BnP	y = -0,0012x + 2,4124	4	0,1398	forecast accuracy does not guaranteed
FBn	y = -0,0019x + 3,8435	5	0,5123	forecast accuracy does not guaranteed

4. Paper currency protection mechanisms classification

Today there are many different mechanisms of the paper currencies protection, but these mechanisms do not systematic. To organize these methods was formed the table represented below (Table 2).

Table 2. Protection mechanisms classification

№	Name	Description	€/ ₽/ ₴/ $	Rank/Rank*	Name
1	Watermark	The image seen when the banknote is against the light on a white plane of the banknote in different colors (lighter and darker than paper) of the portrait, formed the internal structure of the paper and which repeats the portrait printed on the front of the banknote.	1/1/1/1	2/5	Artistic composition

2	Glossy stripe	Vertical polymer tape, which is located deep in the paper and can be seen against the light.	1/1/1/1	3/4	Watermark
3	Raised print	Elements of printing into the banknotes that protrude above the paper surface, asperity of which felt with touching fingertips	1/1/1/1	17/17	Protective tape
4	See-through number	The drawing, located in one place on the front and back sides of the banknote. Its elements coincide and complement to each other when considering against the light	1/0/1/0	18/18	Optical effects
5	Ultraviolet (UV) print	The gradual transition of one color of protective grid to another, made with unbroken lines.	0/1/1/1	11/9	Sign for the blind
6	Copy protection feature	Fine lines that are located at different angles and create the "moire effect" (protective mesh) when scanning or copying the banknote.	1/1/1/1	23/23	Set of graphic elements
7	Encoded latent image	Hidden digital denomination image visible by looking at the banknote on eye level under an acute angle against the light, when it turn on 45 degrees (rectangular pattern on the right of the portrait).	1/1/1/1	25/25	Fluorescent number
8	Microtext	The inscription of continuously replicated word abbreviations of National Bank, which can be read with the help of magnifying glass.	1/1/1/0	30/30	Relief printing
9	Blind sign	The relief element that felt with the touch by fingertips and placed in the lower left corner of the banknote front side, and determine its denomination.	1/1/1/1	5/2	Physico-chemical protection
10	Security threads	The blue and red fibers randomly placed within the paper surface on two sides of the banknote.	1/1/1/1	14/14	Serial number
11	Invisible protective fibers	Chaotically placed within and on the surface of paper fibers on both sides of the banknote that rays with, yellow, blue, blue and green.	1/1/1/1	20/20	
12	Emerald number	Printed banknote number by high printing method with the black color and with equal intervals between numbers, which fluoresces with light green and light red in the ultraviolet.	1/1/1/1	7/6	
13	Magnetic number	Printed series and number by printing black paint method horizontally in one row and with equal intervals between banknote numbers that have magnetic properties.	1/1/1/1	13/13	
14	Standard UV light	Printed denomination in the center of the banknote face side which the help of invisible ink, which fluoresces with light green in the ultraviolet.	1/1/1/1	24/24	
15	Fluorescent printing	Design elements of surface and top face of the banknote and a coded picture that rays with yellow, green or yellow-green (depending on denomination).	1/1/1/1	15/15	
16	Relief printing	Printing type of which are made banknote numbers.	1/1/1/1	8/8	
17	Orlovsky printing	The sharp transition of one color to another without breaking or offset drawing lines.	1/1/1/1	12/12	
18	Portrait window	The drawings of the famous people and buildings	1/1/1/1	1/7	

19	Light element of the watermark	Graphic sign image of the national currency of the country, located in the lower left of the portrait image.	1/1/1/1	19/19	
20	Banknote number	Assign to each banknote their individual number and production series.	1/1/1/1	10/10	
21	Paper	The use of fibrous material which the pulp wood as usual, but for improving the quality, use - cotton, linen and other fibers as usual, too.	1/1/1/1	16/16	
22	Set of graphic elements	Graphic elements that include foil, microtext.	1/1/1/1	6/1	
23	Optical effects	Strokes with regular strokes and a fixed distance between them.	1/1/1/1	4/3	
24	Colourless stamping	Colorless relief image that is applied to colored or non-printed paper area and can be observed through considering the light.	1/1/1/1	26/27	
25	Physico-chemical protection	Type of the banknote protection from the chemical and physical damage, with the help of a special paints and paper composition.	1/1/1/1	9/11	
26	Holographic protection	Type of protection, which include color change with a change in viewing angle.	1/1/1/1	22/22	
27	Iris printing	Pantograph multicolored background, which makes it difficult color photocopying or scanning.	1/1/1/1	27/26	
28	Tint with transparent and unranspare nt elements in the form of grain	Multi-protective element formed on the surface of paper or polymeric carrier by offset printing or flexographic printing raster color images as equally spaced elements, such as spots or dots. Print raster elements may have a complex configuration, and their inner regions may differ not only in color but also in texture.	1/1/1/1	28/28	
29	Using the metameric inks	Monochrome colors, that show the contrast properties to infrared radiation.	1/1/1/1	29/29	
30	Foil stamping	The metal foil laminated to paper. Often, in addition to the colorless foil embossed relief images and on top of it printed images and text.	1/1/1/1	29/29	
Weight			30/28/29/29		

Step 1: based on the Internet analysis method (described in paragraph №1) were obtained frequency values by this method (its demand) on the result of the calculation.

Step 2: according to the calculation's results, weight coefficients were calculated for each method that has provided the results valuation for the temporary periods. The formula: = U2 / SUM ($ U $ 2: $ U $ 31).

Step 3: calculation of an average weighted for each method throughout the research period (1990-2016). The formula: = AVERAGE (C2: M2).

Step 4: the weighted average grades matrix calculated these values ranges. The authors suggested that the correction rank does not need.

Step 5: correction implementation of the ranks calculated by formula: = (COUNT (N2) + 1-RANK (N2; $ N $ 2: $ of N $ 31; 0) is the rank (N2; $ N $ 2: $ of N $ 31, 1)) / 2.

Step 6: protection mechanisms rearrangement.

Step 7: allocation the Top 10 of the most used (demanded) protection mechanisms based on sorting. Table 2 grayed out.

All this facts allow to conduct the comparative analysis of these bank currencies protection mechanisms: the American dollar, the euro, the ruble and the hryvnia, and determine which one is the most protected.

Thus, the protection mechanisms classification (Table 1) is the first step in the selected research. In addition, it can be used for further analysis and for considering mathematical model to more accurately compare levels of protection each of the chosen bills.

5. Mathematical model interpretation of optimal protection choosing of our chosen currency banknotes

To formulate the mathematical model of optimal protection choosing of our chosen currency banknotes we introduce the following notation and integrate the indicated task in the following form:

1. denote variable i – number of protection mechanisms that form the set $\{PM_i\}$ – protecting mechanisms;

2. denote variable j – number of protection mechanisms that form the set $\{CB_j\}$ – currency banknotes, moreover $i \neq j$ ($i = j$ case will be considered as exception to this statement).

Arguably, if $V\{CB_j\}_{j=k} = Ø$, then the current task non-existent because no single research facility.

Assumption 1: minimum amount of protection mechanisms is $V\{PM_i\} = 1$, otherwise consider that the currency unprotected.

Assumption 2: the minimum amount of the banknote types that protected must be formulated with the minimum amount of research objects: $V\{CB_j\}_{j=k} = 2$.

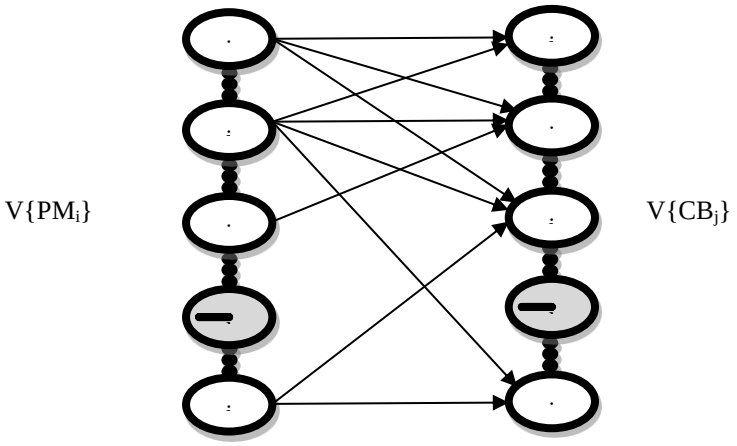

Fig. 6. Graph C_R

Then, for further interpretation let us apply the graph theory [4; 5, p. 21, 35, 60], with the help of which was obtained C_R graph shown on Fig. 6.

Mathematical interpretation. Based on the graph C_R (shown as dicotyledonous graph) the mathematical formalization of currency protection model selection:

$$F = opt\{PM_i\} | \forall V\{CB_j\}_{j=k} \neq Ø, \quad (1)$$

with restrictions

$$V\{CB_j\} \neq \emptyset, |_{j=k};\ k \subseteq \{j\}, \quad (2)$$

$$\min V\{PM_i\} = 1; i = 1 \div n, \quad (3)$$

$$\min V\{CB_j\} \geq 2; j = 1 \div n, \quad (4)$$

$$i \neq j. \quad (5)$$

6. Conclusion

Thus, the problem of currency protection choosing was interpreted with the help of graph theory apparatus, that allows formalize the problem as a problem of linear programming with functionality (1) and defined constraints (2-5).

The following categories were selected for researching: "banknote protection", "banknote", "paper currency protection", "false banknote", "paper currency". It was suggested the author's classification of the paper currency protection mechanisms in a systematic way, what made it possible to rank and identify the most important protecting mechanisms, presented as the Top - 10 (shown in the far right column of Table 2). With the help of the generated classification was developed mathematical interpretation of optimal currency protection model selection, what allows formalize the problem as an integer linear programming problem.

For further researches the authors propose some ways: on the basis of the proposed mathematical model in the form of Integer Linear Programming to improve the mathematical interpretation with using other well known techniques and approaches; obtained mathematical interpretation [19] allow modeling and according to the results obtained a qualitative comparative analysis, thus choose the most optimal solution.

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Ecotourism as a Priority Direction of Sustainable Tourism Development

Alexander Zyma[1], Olga Zyma[1], Mariia Holub[1], Ivan Mikheev[2]

[1] Simon Kuznets Kharkiv National University of Economics, Kharkiv, Ukraine
olyazyma@ukr.net, zima@hneu.edu.ua, mariia.holub@m.hneu.edu.ua

[2] Kharkiv Educational and Scientific Institute of the University of Banking, Kharkiv, Ukraine
i.a.mikheev@gmail.com

Abstract. The paper reviews current trends in ecotourism development in the world. In this article, the contribution of eco-tourism in the economy of the world and Ukraine was evaluated. The basic global issues that directly affect the implementation of ecotourism were analyzed. Besides, the characteristics of these problems were given. The research identified and analyzed the dynamic changes in travel costs after exposure to global problems. The migration in the world was described, and given the impact that unauthorized migration has on the development of ecological tourism. In addition, in the article, the authors study an analysis of climate change and changes that have occurred in various tourist destinations. In addition, the main ways, which can begin active ecotourism development and, in turn, will help to reduce the impact of global issues, were depicted.

Keywords. Ecotourism, global risk, sustainable development, migration, climate change, tourist's arrivals, tourists spending.

1. Introduction

The current state of environmental pollutants in the all countries is a testament to the need to resolve the issues of efficient use of natural resources. Another important issue for Ukraine is the international integration to the world economy. On the one hand, it is a sustainable development of industrial areas. On the other hand, there should be given the need for simultaneous combination of economic and environmental interests of Ukraine. That is why the problem of developing ecological tourism not only in Ukraine, but also all over the world is crucial nowadays. Such scientists as G. Miller, A. Drozd, A. Beidik, G. Guzhin, M. Belikov, E. Ledovskih, A. Kosolapov, V. Klimenok, M. Maya, M. Birzhakov, L. Slepokurov, V. Emelyanov, A. Dmitruk, V. Sergeev, V. Stepanitsky, J. Olejnik, V. Getman, O. Lyubitseva, K. Staschuk etc., studied various aspects of the development of ecological tourism.

The purpose of this article is to review the issues of ecotourism development in order to solve modern problems in tourism market. The ultimate goal is to clear up all the aspects of global problems influence, to analyze the experience and to find out the best way to solve these problems**.**

2. The features of the ecotourism concept

While over the last decade there has been considerable progress in deepening the practices of ecotourism, it still remains far too common [1] and it is frequently classified with and equated to other forms of tourism such as "sustainable", "responsible", "nature", "green",

"low impact", 'geo", "adventure" tourism among others. This complicated the picture and created confusion to the tourism industry and the public in general.

Although ecotourism may share some of its aspects with other forms of tourism, it should be viewed as distinct from the other categories of tourism (Table 1). When properly understood, ecotourism goes further by striving to respect and benefit protected areas as well as the people living around or on the land [1].

Table 1. Categories of tourism [2]

Nature tourism	Travelling to unspoiled places to experience and enjoy nature. It involves moderate and safe forms of exercise such as hiking, biking, sailing and camping.
Wildlife tourism	Travelling where the main attraction is to watch animals, birds, and fish in their native habitats.
Adventure tourism	Nature tourism which requires physical skill and endurance (rope climbing, deep-sea diving, bicycling, water rafting or kayaking) and involves a degree of risk taking, often in little-charted terrain
Alternative tourism	Tourism with a small or specialist market, or product that is distinct from mainstream or mass tourism.
Green tourism	An early term essentially synonymous with ecotourism, but never very well defined.
Cultural tourism	Tourism that focuses on exposing or introducing tourists to different local cultures.
Outdoor tourism	All forms of tourism that take place outdoors including high-impact and consumptive tourism such as motorized vehicles, hunting, etc.
Sustainable tourism	Sustainable tourism is "envisaged as leading to management of all resources in such a way that economic, social and aesthetic needs can be fulfilled while maintaining cultural integrity, essential ecological processes, biological diversity and life support systems"

A clear distinction should be made between the concepts of ecotourism and sustainable tourism (Fig. 1). The term ecotourism refers to a sub-sector within the tourism industry that focuses on minimizing environmental and cultural consequences, contributes to conservation, community projects, and environmental education. On the other hand, sustainability principles apply to all types of tourism activities, operations, establishments, and projects, including conventional and alternative forms [3].

Because ecotourism was originally just an idea, not a discipline, many business and governments promoted it without an understanding of its most basic principles. The international Ecotourism Society has tracked the results of stakeholder meetings since 1991 to develop the set of principles, which are being embraced by a growing constituency of non-governmental organizations, private sector business, governments, academia and local communities [4]. Nevertheless, the ultimate goal of ecotourism is to create a sustainable resource that protects both the people and the nature involved, we can say, that it can provide a great amount of money.

Thus, we can assume that ecotourism is a type of tourism that contains features like nature preservation and sustainability. This concept is a great explanation to reloading the entire tourism industry, because the modern world cannot survive without the biodiversity of

the environment, protection of natural and cultural heritage. An important question is that ecotourism should be considered not only one of the only forms of tourism, but also the basis for government strategic management [5].

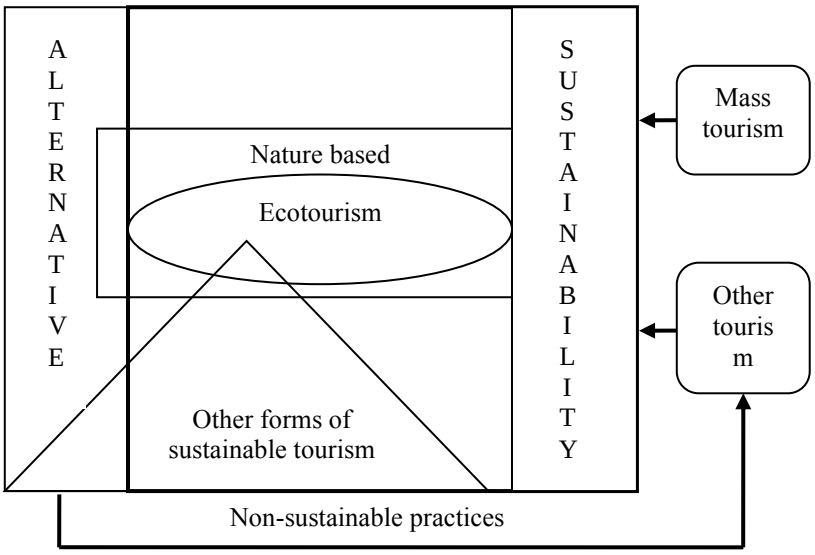

Fig. 1. Position of ecotourism within the tourism spectrum [2]

3. The tendency of ecotourism development

Ecotourism is a growing niche market within the larger travel industry, with the potential of being an important sustainable development tool. With billions of dollars in annual sales, ecotourism is a real industry that seeks to take advantage of market trends. At the same time, it frequently operates quite differently than other segments of the tourism industry, because ecotourism is defined by its sustainable development results: conserving natural areas, educating visitors about sustainability, and benefiting local people [4].

Nowadays we can observe the rapid increase in the tourists' awareness because of the importance of careful attitude to our nature. Many scientists believe that global problems have materialized in the form of risks that are diverse in nature. For example, we observe the processes when stable society becomes fragmented, resulting in deterioration of the global economy. However, according to a study of the Government Office for Science, London [6] in addition to climate change, there is a problem of migration. Scientists note that the current state of natural resource usage and the amount of manufactures will lead to profound changes in human environment worldwide over the next 50 years.

Thus, tourism is an excellent vehicle to transfer income from developed countries to developing countries. Ecotourism is especially effective in this transfer since travelers often venture into remote and economically disadvantaged regions. Since tourism is a relatively barrier-free service export, it can be a more effective means of transferring income from the developed world relative to other forms of foreign investment such as export-processing zones in which profits may be largely repatriated [7].

The benefits of ecotourism flowing to local businesses are also dramatically higher than those from mass tourism. Standard all-inclusive package tours typically deliver just 20 per cent of revenue to local companies, while airlines, hotels and large tour companies capture the rest.

In contrast, ecotourism operations that are based and hire locally can return as much as 95 % of in-country expenses to the local economy [8].

The ecotourism industry also has opportunities for the collection of conservation fees and donations for visits to protected areas. Most eco-tourists have above-average income and are willing to pay entrance fees that will enhance conservation and are shared with local communities. Protected area authorities and local communities for conservation measures and sustainable practices [7] can use this revenue.

According to research which was made by the Association of Travel and Trade, Washington University and consulting firm Xola [9], it was found that in 2012, ecotourists spend approximately 28 billion US dollars. This research was repeated in 2013, and it was found that the growth rate of this sector would increase by 195% within two years [9]. Based on the study, which was conducted under the United Nation Environmental Program (UNEP) [10], it was found that local enterprises earnings from providing ecotourism services are higher than from providing standard tourism services. Therefore, relying on the foreign countries experience, which succeeded in ecotourism development. It can be said that the implementation of ecological tourism in Ukraine, can provide the great results in profit increase from tourism sphere. According to recent World Travel & Tourism Council [11] studies from 2005 to 2015, tourism has made about 8% contribution to the total Ukrainian GDP (Fig. 2).

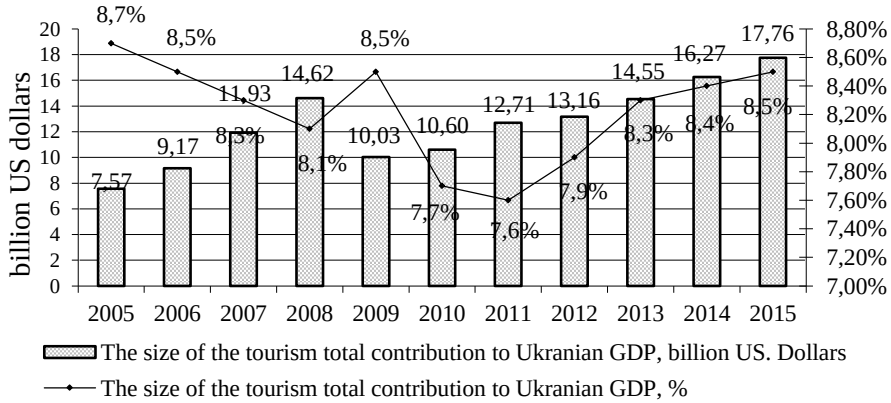

Fig. 2. The tourism contribution to Ukrainian GDP in 2005-2015 years (constructed by [11])

Note that since 2009 the amount of total contribution into the GDP from tourism has increased from year to year. It is necessary to pay attention to the fact that, despite the positive dynamics of tourism total contribution to GDP in Ukraine, we see that the modern understanding of the importance of implementation alternative types of tourism are still at the stage of inception.

There are quite favorable conditions and resources for the development of ecotourism in Ukraine. Unfortunately, underdeveloped tourism infrastructure has led to the fact that ecotourism stays behind global trends. As many scientists estimate, there is a great potential for the development of ecotourism in protected areas. However, it is important to remember, that ecotourism is not only a holiday reserved territories but also preserve "wilderness" in the mountainous and woodland territories of Ukraine. Ukraine has great recreational potential, and with the right approach ecotourism can become a great part in the process of the replenishment of the state budget.

4. Global problems that affect ecotourism development

At the present stage of human development the most urgent issue while travelling, is safety. Moreover, the scientists V. Ponomarenko, T. Klebanova and N. Chernova [12] pay attention to the fact, that government security monitoring system should be implemented in order to increase not only the competitiveness of tourism companies but also the whole economic level of regions or country.

It is clear that the countries which inevitably experiencing political revolutions will have reduction in the number of international tourists. There is not any country, which can protect its tourism sector from the consequences that have developed due to the instability of the political system.

An example is Egypt, which has such problems over the last decade. In 2005 in Sharm-el-Sheikh and in 2006 in Dahab, terrorist attacks were organized, through which 23 Egyptians and tourists were killed. This situation caused a loss of 8% of foreign earnings from tourism. In 2011, after the resignation of President Mubarak, the Egyptian tourism market suffered from a decline in annual revenues from tourism of 14 million USD to 9.5 million USD. History repeated itself two years later when the political turbulence that led to the ousting of President Morsi, was the reason for the decline in tourist arrivals of 11.5 million trips in 2012 to 9.5 million trips in 2013 [13]. Another example is Lebanon. According to the Travel & Tourism Competitiveness Report 2015 [13], during the Lebanese-Israeli war in 2006 and the number of episodes of violence in 2008, the revenues from tourism fell down by 17.3%.

Tourism receipts can decline even more steeply than tourist numbers as the nature of tourist profiles changes-wealthy, security-sensitive segments are replaced by more price-sensitive, risk-taking tourists. For example, following Ukraine's 2008 political crisis, total tourist arrivals did not decline but tourism receipts declined by 20%, implying a decrease in the per-tourist spend [13].

After analyzing the changes in average spend per inbound tourist in countries, which had different types of political crisis, we can conclude that each of these countries also had economic change. Thus, the average spend per inbound tourist in Thailand fell by 9%. At the same time, the political situations in Ukraine led reduce travel costs by 21%. In Egypt there is a situation where the level of tourist travel costs decreased only by 6% (Fig. 3).

Examples can be also found in other regions of our world. In Thailand, there was a decline in tourist's confidence, since December 2008, when international airports began to close and many foreign travel agencies have left the country. This led to a reduction of 3% in foreign tourist arrivals and a decline of 12% of earnings from foreign tourism.

According to The Travel & Tourism Competitiveness Report 2015 [13], there is a vicious circle: the political instability leads to a decrease in demand, private and government investments, tour operators and travel agents reduce their activity as a result of lack of orders or fear of the tourist safety. Because of these factors, it is impossible to implement anything into the tourism sphere. For example, one of the biggest German tourism operator TUI reported a loss of 46.4 million Euro in the first quarter of 2012 mainly due to weak travel demand to North Africa because of an outbreak of Ebola virus.

The second global problem, which affect ecotourism development, is failure of climate change mitigation and adaptation. Climate change is one of the most serious threats to society, the economy and the environment. Changing climate and weather patterns are already changing travel demand and tourist flows, and this in turn is influencing tourism businesses, host communities and other related sectors such as agriculture, handicrafts and construction [3]. As temperatures rise, the attractiveness of many destinations will fade. Winter sports will become less viable in some locations. Coastal tourism is highly vulnerable to rising sea levels [15].

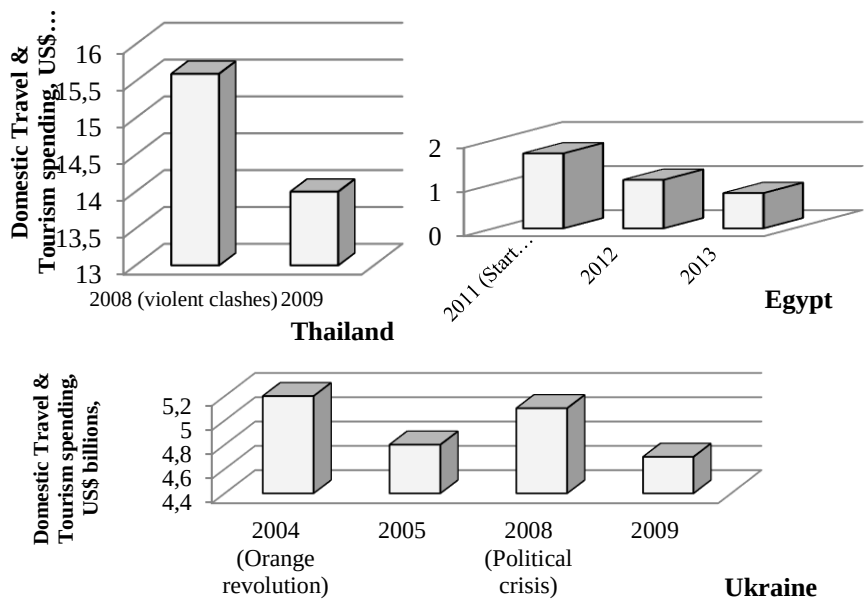

Fig. 3. Change in total domestic Travel & Tourism spending, selected countries [14]

Environmental responsibility also makes economic sense – increased efficiency means greater profits and reassurance of long-term sustainability for investors. In addition, demand for responsible business is increasing, as consumers are more conscious of the environmental implications of travelling [3].

Climate change is a challenge requiring the participation and support of all tourism stakeholders – it is only through effective collaboration that the tourism sector will drive a global response to climate change [3]. The analysis of vulnerability to climate change is a key element in the development of current and future management strategies for tourism destinations. It requires consistent and structured methodologies of adaption [16].

Another global problem, which has a great influence on the ecotourism development, is migration process. Global refugee flows have reached a level that is unprecedented in recent history.

In 2014, 59.5 million people were forcibly displaced in the world, compared to 40 million at the time of World War II [17]. More than half of these recent refugees come from three conflict-ridden countries: Syria, Afghanistan, and Somalia. The trend is upwards: during 2014, the number of people displaced – 42,500 per day – was four times greater than in 2010. Overall, these factors increase the bad influence on the environment, level of life, etc. posed by involuntary migration. Of course, ecotourism can hardly develop in such conditions.

First, people stay in host countries longer than they used to. The average duration of displacement lengthened from nine years in the 1980s to 20 years by the mid-2000s. Less than one in 40 conflicts is now resolved within three years and more than 80% last for more than 10 years. In Europe, the rapid inflow of migrants in 2015 challenged local financial and absorption capacities and exacerbated the trend towards polarization of societies and the political spectrum, which in turn undermined the efficiency of European governance structures [17, p. 3].

Second, the global humanitarian architecture is not able to effectively respond to today's challenges. Many countries, including some of Syria's neighbors, have either not

signed the Geneva Convention governing the status of refugees, or do not uphold it because there is no enforcement mechanism. Moreover, the Geneva Convention does not cover environmental migrants, whose numbers are expected to rise for reasons explored above.

Third, most forced migrants move to other developing countries, where social and governance systems may already be weak or likely to fail. In 2014, 86% of refugees lived in developing countries and about 12% in least-developed countries. All these factors, if unaddressed, can fuel risks in host and destination countries. Although research on the economic effects of refugee inflows is limited, it suggests that refugees can make a positive contribution to the host country's economy through increased demand, inflows of remittances, promoting the use of technology and engaging in international trade.

Therefore, all the problems that affect tourism lead to the administrative barriers that hinder the movement of people between countries. In this case, the old practice of the process of issuing visas and border controlling. However, this system is improving, according to research by UNWTO, the share of global travelers who have to apply for a visa decreased from 77% in 2008 to 62% in 2014 [18]. Indeed, the visa facilitation process generates about 89 billion USD additional revenues from international tourism and 2,6 million additional jobs in countries in 2016 [19].

The next aspect is that following a change that has an impact on the tourism sector, is increasing difficulty in hiring professionals. Studies show that for every 30 new tourists one job is created. It is believed that the area of aviation and tourism is the largest employer in the world. In addition, this area has a great potential for future job creation. Now there is a lack of professional personnel. Thus, the public and private sector should work closely and update training programs at universities to ensure the needs of the market and meet the technological achievements of mankind. As noted scientist V. Ponomarenko [20, p. 127], it is necessary to develop the curriculum to meet the current and strategic needs of a range of customers, the public needs that require accented formation of existing competences.

An important factor is the process of changing the tourist demand. The services that enterprises provide now should be analyzed in detail, due to the fact that the demographics are changing, and with them the needs of tourists are changing too. However, modern tourists pay more attention reducing the negative environmental impact in terms of ecology.

One of the best ways to solve the problems mentioned above is to change the orientation of international tourism on the inside. A great example of such changes is Thailand. In 2008, the government of that country began to collaborate with the private sector to organize a "Travel Fair Thailand", under which it was established that local airlines, hotels and other tourism enterprises were been reduced tax rate, so prices fell and the number of domestic tourists increased. However, revenues from domestic tourist cannot always fully compensate the losses that have been incurred due to the fact that foreign tourists usually spend much money than domestic. It should be noted that the development of ecotourism will help to attract the attention of not only Ukrainian, but also foreign tourists due to the fact that they pay attention to environmental protection, and actively taking part in ecotourism trips. The ecotourism development of can provide an increase in real incomes for rural population by [9, p. 142]: providing services related to accommodation of tourists; arranging tourist routes and providing tour services; transporting services to tourists; provision of tourist equipment rental; production and sales of tourists organic foods, providing culinary services; handcrafting of goods; entertaining activities based on historic and ethnographic heritage (animation).

In addition, in order to reduce these risks and to reduce the negative impact of problems of various kinds, it is important to make technical progress and introduce innovative processes that can improve the efficiency and safety.

Thus, global problems that directly arisen in Ukraine, are important to be solved, because of not only the process of effective ecotourism implementation, but also the formalization of ecotourism potential assessment system.

Moreover, as noted in the National report "Social and economic potential of sustainable development of Ukraine and its regions" [21, p. 598], one of the most important tools for long-term sustainable development of our country is considered to be the creation and development of companies small and medium businesses, giving them easier access to capital, business development associated with tourism and cultural heritage of the regions.

5. Conclusion

To sum up, ecotourism is a fast growing sphere of tourism, with the potential of being an important sustainable development tool. This type of tourism has its principles, which distinguish it from others. Moreover, it operates differently than other types of the tourism industry, because ecotourism is defined by its sustainable development results: conserving natural areas, educating visitors about sustainability, and benefiting local people. Unfortunately, there are so many global problems which can lead to not only ecotourism development recession, but also to the recession of economy, social life and ecology overall. Thus, ecotourism is considered as one of the best green options for addressing poverty, employment and economic diversification initiatives in developing. Sustainable tourism, in particular, has the potential to create new jobs, reduce poverty, and increase export revenues.

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Albania Power Market: Day-Ahead Price Forecasting of Electricity Markets

Jorida Ajçe (Konica)

Distribution System Operator, ESS, Tirana, Albania
Jorida.ajce@gmail.com

Abstract. Albania has signed up to implement the EU Target model through the Energy Community as well as through the new Energy Law. A Day –Ahead market would help Albania to minimize its import bill, exporting peaking power at good price during day time via the Day-Ahead market and importing off – peak power at low prices during night – time via the Day-Ahead market. Sell reserves to thermal with large, old and unreliable thermal plants. Market adoption of the model in Albania will require a technical and appropriate for forecasting the price of electricity for Day-Ahead, variety of methods and ideas have been tried for electricity price forecasting (EPF) over the last 15 years, with varying degrees of success .Price estimation has become a very valuable tool in the current upheaval of electricity market deregulation. It plays an important role in power system planning and operation, risk assessment and other decision making. We are a relatively new market and without knowledge, so we will try to find the best model for predicting the price of energy in the market Day – Ahead, making a review of the state-of-the-art with a look into the future. Will use the method is to predict the price of electricity is fuzzy logic and the results are very promising.

Keywords. Electricity Price Forecasting, Day – Ahead market, Electricity market**,** Electricity market

1. Research Motivation

After the adoption of the new Law on the Electricity Sector, Albania is taking concrete steps to liberalize the energy market. The law defines a clear timetable to what extent and under what terms will be realized opening of the market. In function of this process will be realized and legal intervention to create new market model. Part of the energy market, which aims to increase transparency in the underlying transaction of energy, will be the energy grants. It will be the mechanism to achieve physical and financial transactions energy flows. The success of this bourse will depend on the amount of energy flows that will be traded in. In this context, Albania will use the collaboration of the government of Norway to realize the project of creation of the stock market and energy in Albania. Norwegian experience is intended to be used as a success story in the creation and functioning of the energy market. In the draft for the new energy market, the Ministry of Energy has concluded that the best starting point for an electricity market is considered to be a market Day-Ahead for Albania aimed combination of exchange more energy efficient neighboring countries. A Day-Ahead market is considered one of the best international practices to achieve economic efficiency in the energy sector, through short-term commercial terms. It is also in accordance with current agreements signed with the Energy Community and the model of the EU target and is being implemented in other countries. This market fits Albania because it has the opportunity to reserve power from dams. For example hydro reserves can be sold for much, if suddenly a plant in neighboring countries sudden defect. Hydropower allows cross-border long-term bilateral contracts and thus, makes

long-term predictable income. Day-Ahead model to be applied by the Exchange enables qualified customers to buy electricity in accordance with the initial goal of liberalization, either directly or through suppliers. Albania is part of one of four areas of control in the region of Southeast Europe. The current trade with Eastern Europe is based on bilateral contracts and auctions organized by the Transmission System Operator. The design of the proposed market will not bring any change in the obligations of TSOs and its accounts, but Day-Ahead-Market (DAM) should replace most internal contracts bilateral Albania and an important part of cross-border trade It will be areas that will be set up specifically for this purpose. Power prices will flow from an area with low price in a high area. Moreover, the Albanian TSO is recommended to reserve a portion of the transmission capacity at the external borders. The market for Albania, thus, will be designed in accordance with the European rules. European energy exchanges will bring transparency and predictability for market participants and investors across Europe. Albania so will benefit from the harmonization and integration of these markets and that allows international investors to participate in the Albanian market based on the same model applied in other markets.

Albania Power Exchange will trade at a market model that is collateralized to minimize market risks. Bursa also offers a flexible arrangement to allow the inclusion of more areas of the market as a single market. Energy trade with neighbors will be done through the creation of areas of importexport linked together through auctions. According to the new model of energy market import-export zone will be established on the border between Albania and Kosovo. Part of the capacity will be as common reserve, while the remaining capacity will be marketed by auction free zone for bilateral import-export. A second area of export-import will be on the border between Albania and Montenegro. A third area of export-import will be for trade with Serbia and fourth areas of cross-border energy trade, be it Greece-Albania. The new model suggests that the market of export-import zones to register with the Energy Exchange as any other market participant.

This is implementing the EU Target model as well as the agreed Energy Community model, a spot market for Albania alone would have an annual consumption of (say) 7.7 TWh, which may be compared with the power cost-based power pools in Panama, Guatemala, Nicaragua and El Salvador with annual demand of respectively 8, 9, 4 and 7 TWh/year. There are several relevant experiences of similar implementations where Albania can benefit from their experiences OPCOM in Romania, TEIAS in Turkey, Croatia Serbia Since the early 1980s, the worldwide electricity industry has undergone numerous and fundamental changes. For many years, these electric power industries have been dominated by large utilities that had an overall authority over all activities. These utilities generally control every activity in the sector such as generation, transmission and distribution of power. These utilities were vertically integrated utilities and in such a system consumers had only one electricity provider and they were paying the tariff set by the utilities. Unlike the regulated market, however, deregulation leads generation, transmission and distribution to be split and independent activities. The main driving force behind this radical change from the intensively monopoly to a deregulated electricity market was the fact that competition could result in an efficient utilization of resources; that leads to supplying the end customer with a cheaper but yet more reliable energy supply. Following the early attempts of Latin America, Britain, Australia, California, and the Scandinavian countries, most countries around the world have found themselves restructuring their respective electricity markets [1].

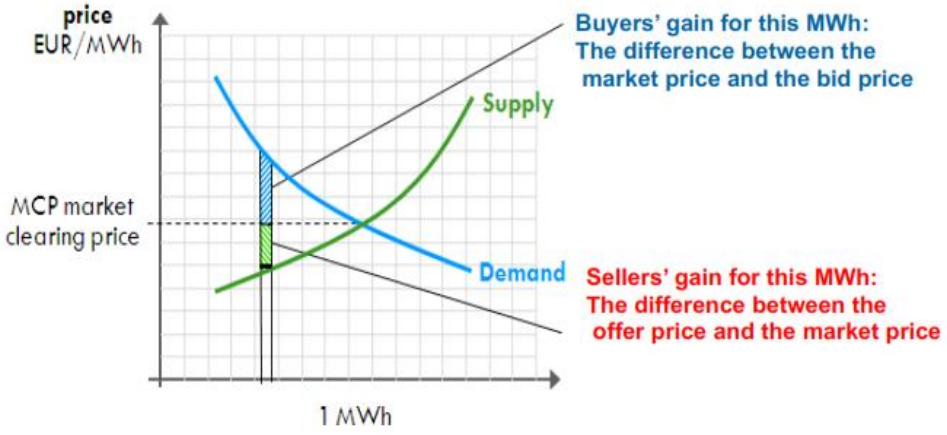
2. Introduction

Electricity is a standardized cross-border traded commodity. Especially in Europe, where an ongoing market integration between countries proceeds rapidly, national markets cannot be considered as one isolated trading place. Electricity is a standardized cross-border traded commodity. Especially in Europe, where an ongoing market integration between countries proceeds rapidly, national markets cannot be considered as one isolated trading place. Several authors have studied the cointegration of European electricity markets empirically within the past years. For instance, Bunn and Gianfreda (2010) showed by employing a spatial analysis for some of the major European electricity markets that they are integrated. Moreover, they provide evidence for an increase in this integration over time. The German electricity market turned out to be the most integrated market. According to their study the integration is not necessarily reliant on sharing a geographical border: The Spanish and German market, for instance, seemed to transmit shocks as well. The important role of the German electricity market for other European markets was also pointed out by Bollino et al. (2013). Using cointegration techniques they find that the German electricity price embodies a price signal for the other investigated European markets, e.g. France and Italy. Even though the hypothesis of market integration for some of the major markets seems to be satisfied (see also Bosco et al. (2010), Kalantzis and Milonas (2010) or Houllier and de Menezes (2012)), it is debatable if this holds true for every European market. Zachmann (2008) as well as Huisman and Kili¸c (2013) argued that especially some of the Scandinavian electricity prices are behaving differently. This issue was also analyzed in detail by Ferkingstad et al. (2011). They were able to show that at least for the weekly time series of Nordic and German electricity prices a connection through gas prices is present. As basic electricity exchange we focus on the Energy Exchange Austria (EXAA) for two reasons. First, the EXAA discloses day-ahead prices prior to most of the other European exchanges which are connected with Germany and Austria. Second, the EXAA contains a special case of price relations, where not only the same time period is traded prior to other markets but also the same market region. This holds true for the European Power Exchange (EPEX) and the EXAA, as both cover Germany and Austria. The EXAA reveals their prices approximately at 10:20 pm, whereas offers to the EPEX can

be submitted until 12:00 pm. If there is a systematic relation between both markets present, traders could use the price information of the EXAA to adjust their bidding structure. This approach is applied to many European exchanges. As the EXAA covers Germany and Austria, we focus only on these European markets, which are directly connected with Germany and Austria. The existent literature concerning the usage of the early price disclosure of the EXAA is very scarce. It was only discussed in the framework of forward risk premiums, for instance in Ronn and Wimschulte (2009) or Erni (2012). In these studies the EXAA price is usually regarded as an early price signal for electricity of the EPEX or European Energy Exchange (EEX) respectively. Viehmann (2011) for instance considers the EXAA prices as a snapshot for the German and Austrian electricity price traded via Over-the-counter (OTC) business. However, a direct application of the EXAA price into modeling the electricity price of other European markets has, to our knowledge, not been done so far [2].

3. Problem Formulation

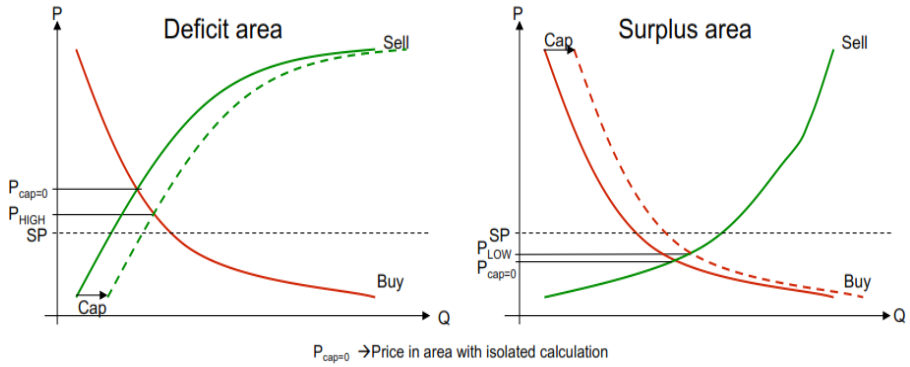
Let be Y_t^* the electricity price of market n in time t. So $Y_t^* = (Y_1^n, ...Y_t^n)$ is the time series that represent the hourly price. In addition we define that $\bar{\tau}(t)$ is the day that corresponds to the time t. Given a day τ we can denote d (τ) as the number of hours that are traded on the corresponding day. Our focus of interest is now the series of Y_t^* especially the values $(Y_{n+1}^*, ..., Y_{n+d(\bar{\tau}(n+1))}^*)$ which we will us to electricity price forecasting for Albania (EPFA). This is the foundation of the "Energy only" market concept



Both the buyer and seller are settled by the balance price in the intersection between demand and supply. The price formation process is therefore economically effective fosociety. The demand sid will pay less than the bidding price and the seller will get paid more than the bidding price fothe calculated contract volume

Quantity = capacity is added as price-independant orders in both surplus area and deficit area. Results in new balance prices:

- Surplus area price < System price
- Deficit area price > System price



$P_{cap=0}$ →Price in area with isolated calculation

4. Factors influencing electricity prices

In deregulated power markets, fluctuation is a common behavior of price which is because of many different economic as well as technical factors. Some researchers have only used historical data of prices [3] or both prices and demand to forecast spot price excluding other factors such as weather, fuel cost and generation reserve.

The factors influencing spot prices may be classified on the basis of :

a) market characteristics,
a) nonstrategic uncertainties,
b) other stochastic uncertainties,
c) behavior indices, and
d) temporal effects.

There are as many as 40 variables used by different researchers. Most of the researchers have utilized past experience in selecting the input variables for their respective model and choice of best input variables for a particular model is still an open area of research. The widely used input variable is the electricity price of previ-ous days [4].

4.1 Electric Power Demand One of the important factors in spot price is system's total demand. Studies show that if system demand increases, spot price also increases.

4.2 Whether Conditions Electricity demand certainly depends on environmental condition and especially daily temperature. Weather fluctuation will affect demand and hence spot price will also be affected.

4.3 Fuel Cost Fuel cost is one of the main parts of generation cost that its variation has a major impact on electricity spot price.

4.4 Available Transmission Capacity Electric power is provided by generator that may be located far from location of consumers. It should be transmitted to consumers via transmission network facilities. There is some physical constraint in transmission networks that is an obstruction for market participants to buy or sell energy. This issue can affect important changes on spot price and may increase it.

4.5 Generation Reserves Having enough generation reserve is an important factor for electricity spot price, i.e. when demand increase suddenly if there is enough generation reserve capacity available as well as deliverable, consumers will be served. But if there is not sufficient generation reserve available, consumer would face with lack of received energy and therefore to make the balance between supply and demand electricity spot price increases.

5. Price-forecasting methodologies

The price-forecasting models have been classified in three sets [4] and these three sets have been further divided into subsets as shown in Fig. 1.

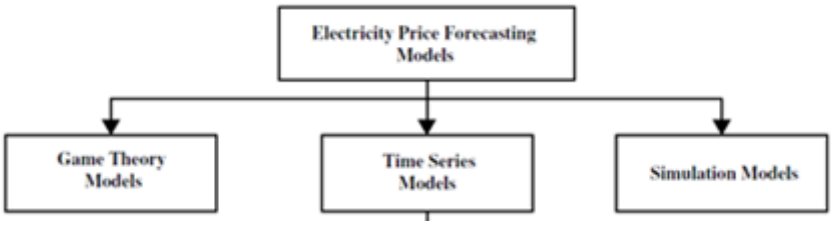


Fig 1. Classification of price – forecasting models

5.1 Game theory models

The first group of models is based on game theory. It is of great interest to model the strategies (or gaming) of the market participants and identify solution of those games. Since participants in oligopolistic electricity markets shift their bidding curves from their actual marginal costs in order to maximize their profits, these models involve the mathematical solution of these games and price evolution can be considered as the outcome of a power transaction game A detailed discussion on game theory models can be foundin [5].

5.2 Simulation models

These models form the second class of price-forecasting techniques, where an exact model of the system is built, and the solution is found using algorithms that consider the physical phenomenon that governs the process. Then, based on the model and the procedure, the simulation method establishes mathematical models and solves them for price forecasting. Price forecasting by simulation methods mimics the actual dispatch with system operating requirements and constraints. Simulation methods are intended to provide detailed insights into system prices. However, these methods suffer from two drawbacks. First, they require detailed system operation data and second, simulation methods are complicated to implement and their computational cost is very high.

5.3 Time series models

There are some methods that can us to for price forecasting, as moving average autoregressive (AR), moving average (MA), autoregressive moving average (ARMA), autoregressive integrated moving average (ARIMA), and generalized autoregressive conditional heteroskedastic (GARCH) have been considered. Stochastic time series can be divided into stationary process and non-stationary process. The basic assumption of stationarity on the error terms includes zero mean and constant variance. In AR, MA and ARMA models conditions of stationarity are satisfied; therefore they are applicable only to stationary series. ARIMA model tries to capture the incremental evolution in the price instead of the price value. By the use of a difference operator, transformation of a non-stationary process into a stationary process is performed. The class of models where the constant variance assumption does not need to hold is named heteroskedastic. Thus GARCH model considers the conditional variance as time dependent. In all these models price is expressed in terms of its history and a white noise process. If other variables are affecting the value of price, the

effect of these variables can be accounted for using multivariate models like TF (transfer function) and ARMA with exogenous variables (ARMAX) models. As electricity price is a non-stationary process, which exhibits daily, weekly, yearly and other periodicities.

Therefore, a different class of models that have this property, designated as seasonal process model, is used.

6. Fuzzy Inference System

In this paper, FIS is utilized to capture the effect of transmission constraints and system contingencies on the next-day price forecasts. An FIS performs an input-output mapping based on fuzzy logic. Contingencies are not number-based data (as presented in Section 3). FIS has four input and one-output variables. Forecasting days including contingencies will enable FIS, and normal forecasting days (without contingency) will not be analyzed by the FIS system. In another word, neural network forecasting results for normal days are the final results, while final results for contingency days are the FIS-edited results. Fig.2 illustrates the proposed neuro-fuzzy system[6].

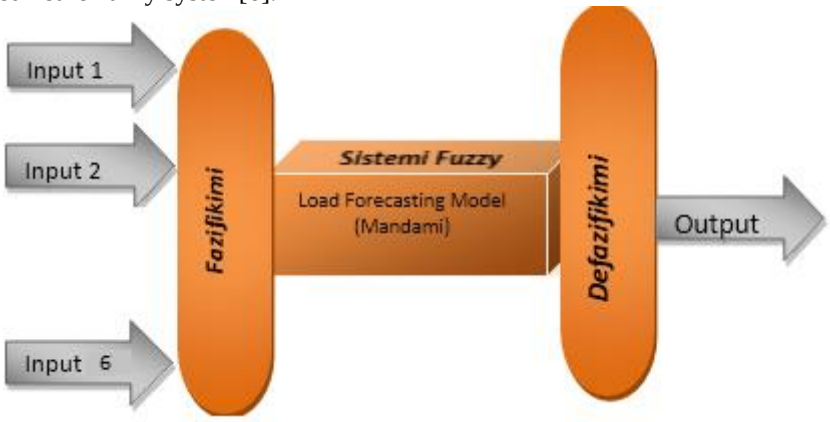


Fig 2. FIS Price forcastin system

Input 1: Time 24h
Input 2: Price 24h (d-1)
Input 3: Load 24h (d-1)
Input 4: Load 24h (d)
Input 5: Temperature (d-1)
Input 6: Temperature (d)
Output: Forecast Energy Price (d)

Period Time is one of FIS inputs. Based on the regional conditions, hours in the next-day caclulation can be divided to 7 sections, as we did and we article [07, 08].

Day time section can be modeled for FIS by tringle or trapezoid membership function. Time section are; “Midnight”, “Early Morning”, “Morning”, “Noon”, “Afternoon”, “Evening”, “Night”, Fig. 3.

Price at contingency hours in forecasting day will be determined by FIS system. Considering the these hours, time membership function should be selected. The next input is forecasting day load for contingency hour.

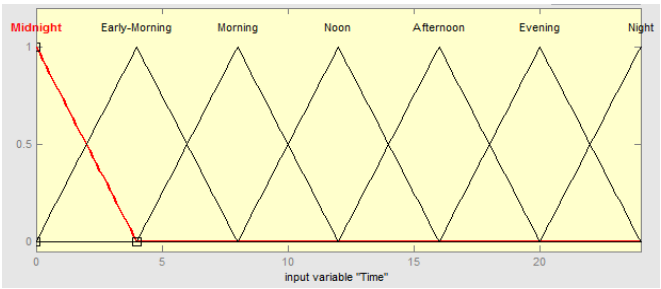


Fig3: Time membership function

The FIS load input is included three triangle membership functions: “Low”, “Medium” and “High”. Load membership function limits will be selected adaptively by load limits in current hour during the training period. Contingency FIS input divided into 5 triangle membership functions: “Very Low”, “Low”, “Medium”, “High” and “Very High”. Contingencies belong to proper membership function based on their importance. FIS output i.e. the final forecasted price at the current hour, is distributed by membership functions: “Low”, “Medium” and “High”. Price membership function ranges will be selected adaptively, by price limits in current hour during the training period. Fig. 4 illustrates an example for FIS output membership functions [09, 10].

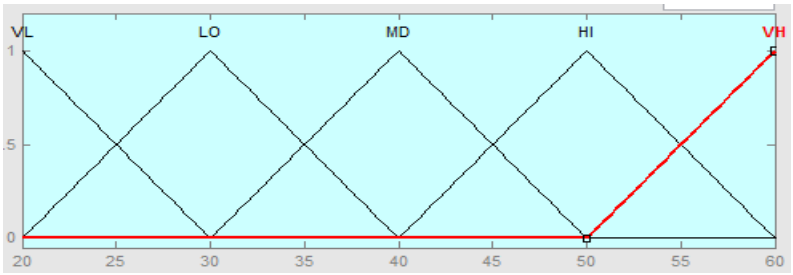
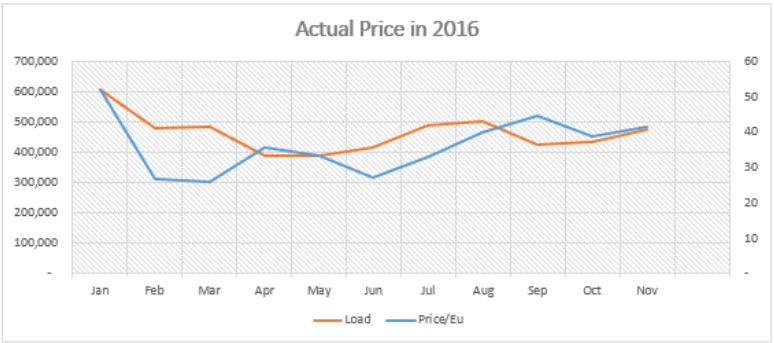


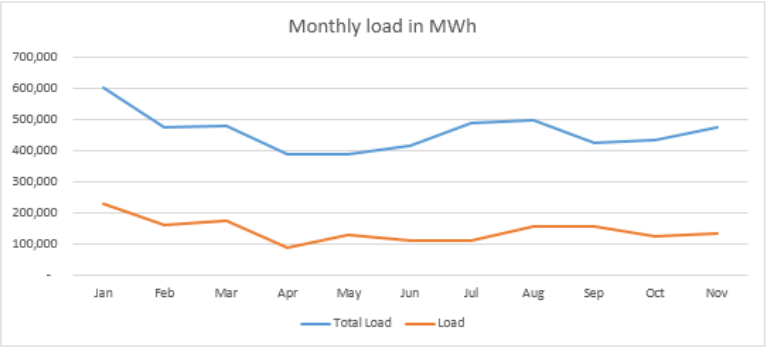
Fig. 4.Output price membership functions

In the table below we present monthly load of the quantity for which we need to buy in the market, and prices at which we bought this energy market

Price/Year 2016	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Total Load	605,348	476,897	481,972	390,070	388,971	415,440	488,434	500,475	426,820	435,091	475,463
Price/Eu	52	27	26	36	33	27	33	40	44	39	42
Load	233,074	162,341	178,320	88,737	133,137	110,879	112,787	159,960	159,960	124,560	134,100

Below the graphical representation of data in the table above, where the total load presented to the monthly electric energy for 2016 in the Albania. the quantity of electricity which could not cover it from domestic production, it is necessary that this amount purchased in the free market.





7. Numerical Performance

Two criterias are commonly used to evaluate the accuracy of price forecasting: RMSE and MAPE [11].

RMSE and MAPE are calculated, respectively, by:

$$RMSE = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(P_{actual_i} - P_{forecasted_i}\right)^2} \quad (1)$$

$$MAPE = \frac{100}{N}\sum_{i=1}^{N}\frac{\left|P_{actual_i} - P_{forecasted_i}\right|}{P_{actual_i}} \quad (2)$$

where N is the number of sample prices, and the terms $P_{forecasted_i}$ and P_{actual_i} are forecast and real prices respectively (i = 1; 2; ... ; N).

Because of the special behavior of the price in electricity markets, MAP-Error from Equation (2) is not suitable for price forecasting evaluations. In some cases, it will caused in unrealistic errors. Therefore, Equation (3) is a new method of using MAPE evaluation criteria.

$$MAPE = \frac{1}{N}\sum_{i=1}^{N}\left|\frac{P_{actual_i} - P_{forecasted_i}}{P_{Average(actual)}}\right| \quad (3)$$

to test our method we have used historical data as consumption time at 24 hours of consumption, for months January 2016, Aprill 2016, July 2016 and October 2016, as we can see in the graphic below,

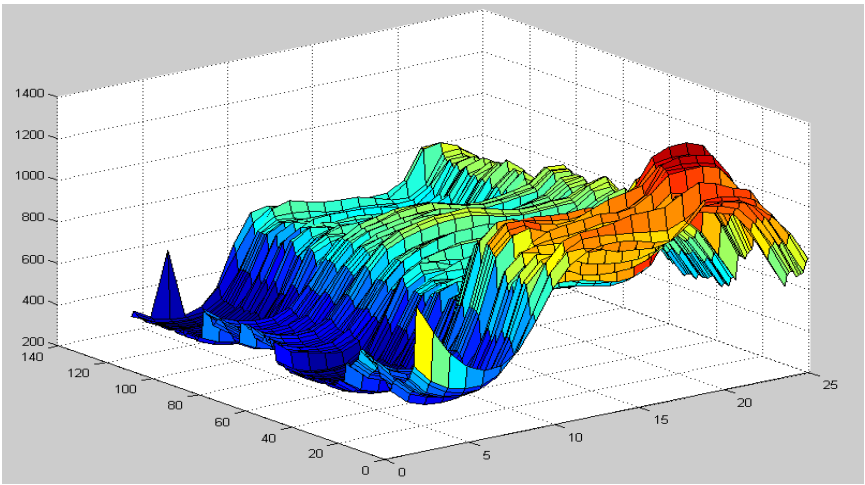


Fig5: Total load in 24 hours Jan, Apr, Jul, Oct 2016

Numerical results of day-ahead price forecasting by aour methods for the year 2016 presented in the tables below

Table1: Results for day-ahead price forcasting Jan, Apr 2016

January-Year 2016		
Weekday	RMSE %	MAPE %
Monday	2.14	3.94
Tuesday	2.19	4.01
Wednesday	2.20	4.05
Thursday	2.14	3.94
Friday	2.17	3.99
Saturday	2.17	4.00
Sunday	2.15	3.98

April-Year 2016		
Weekday	RMSE %	MAPE %
Monday	1.21	4.07
Tuesday	1.46	3.97
Wednesday	1.46	3.95
Thursday	1.47	3.99
Friday	1.45	3.92
Saturday	1.46	3.96
Sunday	1.49	4.04

Table2: Results for day-ahead price forcasting Jul, Oct 2016

July-Year 2016		
Weekday	RMSE %	MAPE %
Monday	1.38	4.10
Tuesday	1.43	4.25
Wednesday	1.42	4.23
Thursday	1.46	4.33
Friday	1.47	4.36
Saturday	1.43	4.25
Sunday	1.41	4.19

October		
Weekday	RMSE %	MAPE %
Monday	1.70	4.22
Tuesday	1.68	4.16
Wednesday	1.64	4.08
Thursday	1.69	4.17
Friday	1.68	4.16
Saturday	1.68	4.16
Sunday	1.69	4.18

8. Conclusion

In this paper we propose a methodology for a the day-ahead elektricity price forecasting for Albania. Our intention is to predict the day-ahead elektricity price forecasting with a much smaller error because only that way can we will monitor the situation, to minimize the cost and to secure a good service to electricity, as we can see above we anticipated energy consumption using fuzzy logic, analyzing and consumer trends, the months of the year and days of the week. The model is based on an Automatic Correlation method forecasting for weekdays, Satuday and Sundays. The related factors, and forecasted loads, historical prices and environment temperatures are considered as the fuzzy reasoning is is considered because of its capacity in treating the linguistic description.

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Principles of Hardware Implementing of Intrusion Detection and Prevention Systems

Durdona Irgasheva, Komil Tashev, Mirokil Yorikulov

Tashkent University of Information Technologies, Tashkent, Uzbekistan
durdona.ya@gmail.com , k.akhmatovich@gmail.com , n.bakhtyarovich@gmail.com

Abstract. This article discusses the principles of construction hardware detection and prevention of attacks based on programmable logic integrated platforms. Results used platforms such as network processors, reconfigurable technology and General purpose processors for hardware implementation of intrusion detection systems. The architecture of intrusion detection systems and synthesis steps for the FPGA as part of the system

Keywords. Intrusion detection system, network packets, firewalls, classification of network packets, preprocessors, Deep packet inspection, FPGA, packet header, header recognize.

1. Introduction

Firewalls have been used extensively to prevent access to systems from all but a few, well defined access points (ports), but they cannot eliminate all security threats nor can they detect attacks when they happen. Stateful inspection firewalls are able to understand details of the protocol that are inspecting by tracking the state of a connection. They actually establish and monitor connections until they are terminated. However, current network security needs, require a much more efficient analysis and understanding of the application data [1]. Content-based security threats and problems occur more frequently, in an everyday basis. Virus and worm inflections, SPAMs (unsolicited e-mails), email spoofing, and dangerous or undesirable data, get more and more annoying and cause innumerable problems. Therefore, next generation firewalls should support Deep Packet Inspection properties, in order to provide protection from these attacks. Network Intrusion Detection Systems (NIDS) are able to support DPI processing and protect an internal network from external attacks. NIDS check the packet header, rely on pattern matching techniques to analyze packet payload, and make decisions on the significance of the packet body, based on the content of the payload.

2. Analysis of Intrusion detection system structure

IDS differ on many criteria, including that, in terms of complexity and structure.

IDS are mandatory in order includes one or more sensors and the user interface. The structure of the sensor, in turn generally includes:

- The module works with sources of information;
- Subsystem of registration data;
- Knowledge base;
- Components of the control module;
- Intrusion detection module;
- Model response.

In this paper we consider only some of the components listed above, the most critical in terms of computational cost, namely intrusion detection module, combined to speed with

the knowledge base, the role which often acts as a database of known attack signatures.

In other studies conducted preliminary analysis capabilities of programmable logic and methods of its use as part of intrusion detection systems. In particular, it was mentioned that the main problem in the protection against external attacks, an effective solution which can ensure the FPGA is essentially resource-signature detection operation in an intense stream of network packets.

Depending on the object to be protected, distinguished IDS:

- Controlling individual computers;
- Analyze the packets of network traffic across the network.

The greatest effect of the hardware solution is achieved in network intrusion detection systems.

Network IDS, actually used in practice at present, are divided into two main classes, depending on the method of analysis of the events:

- Use of the signature;
- Detect anomalies.

Anomaly detection systems, as opposed to using a signature can detect new, previously unknown attacks, but to date, cause unacceptable many false positives. Therefore, a network IDS in the analyzed sources means a system based on signature detection.

The mechanism of functioning of the network intrusion detection system generally consists of 3 stages:

- Capture network packets;
- Filtering and assembly of packages;
- Recognition.

The most resource-intensive is the last step, which is to implement a large number of comparisons the content of network packets with a sequence of characters from the database of signatures.

Analysis of network traffic can be carried out in two ways:

- By the total capture and inspection of all (raw - raw) packets of network traffic;
- Based network protocols (dismantling network packet headers).

Systems based on the first method, a larger number recognize attacks. They do not prevent non-standard port numbers, as well as semi-distortion network packets. But such IDS is much more resource intensive in their implementation. For this reason, in the test system described mainly sources, considering protocols.

The analysis of the experience of building the network IDS using FPGAs allow to formulate requirements for intrusion detection systems to hardware accelerators, as well as the basic parameters by which to assess their effectiveness.

As indicated in other studies IDS performance is determined by two main characteristics:

- Bandwidth;
- Total number of templates that can recognize system.

It should be noted that the performance indicator is not an absolute, it is also important what price is achieved, that is, the cost of equipment and power consumption. Hardware costs when working with FPGA is accepted to estimate crystal size that is used to implement a particular device, absolute or as a percentage of the share of the chip. The units of measurement used in this indicator conditional equivalent logic elements, system logic elements or some of the structural components of a particular FPGA family specific manufacturer - correspondence tables, configurable logic blocks, sections, etc.

An important characteristic of any complex system, to what are the IDS network, is scalability - the ability to gradually build up capabilities without disproportionate Additional

costs. The amount of network traffic and the number of recognizable signatures are constantly changing values, this fact can not be underestimated.

A specific feature of the systems based on reconfigurable intrusion detection signature is a regular need to add new templates database, and as a result, generation and downloading a new configuration of the FPGA. Ease and speed of this operation significantly affect the usefulness of the system.

Due to insufficient productivity software solutions are most contemporary SOC passive, that is, only the signal about the detected breach of security, in addition, usually with a considerable delay, that is, not in real time. The value of the intrusion detection system is much higher in case of intrusion prevention features (Intrusion Prevention System - IPS).

As indicated above, analysis of network traffic at a low level (raw) more efficiently than at the network protocol in terms of information security, but it requires much expensive. Therefore, modern NIDS forced to perform the filtering function and assembly of network packets (filtering / fragmentation reassembly).

As a non-essential, but beneficial qualities should be mentioned hardware implementation of low-level network operations FPGA resources (the so-called built-in network interface) that allows you to reduce the cost of the technical solution as a whole and to increase its flexibility.

3. Generalized IDS structure on FPGA

Formulate in a general way the composition and structure of the hardware implementation on FPGA intrusion detection systems, meeting the provisions and requirements of the above. Figure 1 is a generalized block diagram of the resulting solutions.

The composition structure includes:

- packet receiving unit;
- packet classifier;
- recognition module;
- Alarm generation module;
- the delay circuit;
- packet filter;
- dispensing module packages.

The last three components are present only in the structure for implementing active NIDS intrusion prevention functionality.

Packet reception module provides low-level network packets capturing and transform it into a more convenient for in-processing type of coding, for example, format XAUI (10 Gigabit Attachment Unit Interface) format XGMII (10 Gigabit Media Independent Interface) [2]. Qualifier parses packets based on header analysis up to a certain level depending on the intrusion detection method [3].

Recognition module performs the most resource-intensive computational search operation signatures in accordance with the selected algorithm. The quality of its implementation is largely dependent on the main characteristics of all intrusion detection systems: performance, scalability, and resource consumption for. Consideration of different possible lines of recognition algorithms in the flow of network information used in reconfigurable IDS is beyond the scope of this paper and will be discussed in subsequent publications. In general, for recognition module needed headers and content of network packets, as well as information base of signatures recognition of these rules, including the signatures themselves. Depending on the algorithm implemented by this base or stored separately in the internal memory of the FPGA components, either directly "enclosing" in a recognition processing structure [4].

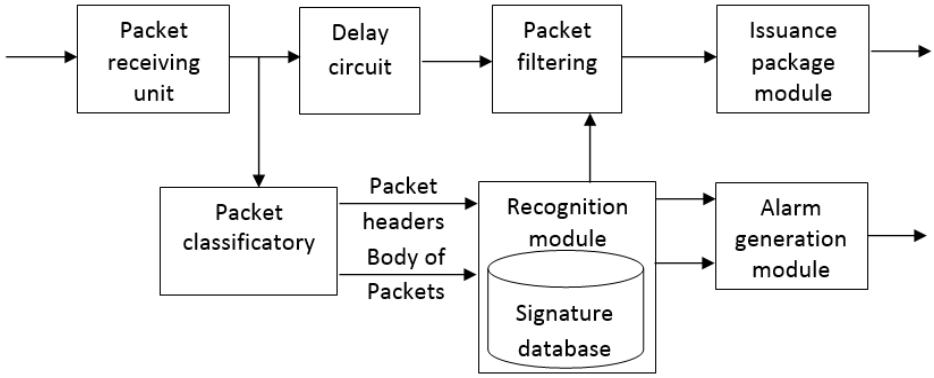

Fig.1. Structure of NIDS on base FPGA

In addition to the equipment, implements its own patterns entering the search algorithm in the content of network packets, recognition module generally comprises a packet header and recognition scheme and the detector base signature database rules.

Module alarm generation is used for the formation of intrusion detection messages. He identifies malicious packets and combines information on the type of attack that comes from the recognition site with additional information from the packet header, allowing to identify the source of the invasion. The generated messages, depending on the SOI structures obtained either in response of the sensor module, or directly via the user interface the security administrator.

A packet filter is used to prevent malicious traffic is detected by discarding packets.

Packages issuing module implements a transformation inverse to that performed in the packet receiving unit.

There are several different implementation platforms for IDS, each having advantages and disadvantages. The first IDSs were built in GPPs, while other commercial products implement mostly only parts of an IDS in fixed-function/dedicated ASICs. Network processors can also be used for IDS offering some dedicated modules for network functions, while reconfigurable hardware may provide the increased flexibility that such systems require.

There is a tradeoff between performance and flexibility in these solutions. General-purpose microprocessors are very flexible, but do not have adequate performance. Network processors are less flexible but have slightly better performance. Reconfigurable hardware provides some flexibility and better performance. Finally, dedicated ASICs are not flexible but can process packets at wire rates.

General purpose processors (GPPs) are used for their flexibility to adapt to IDS ruleset changes and their short time to complete the software development. An IDS implemented for GPPs does not require running the code of every IDS rule for each packet. Based on packet classification a specific subset of rules may apply and can be called. This “on the fly” flexibility is another significant GPP advantage. On the other hand, GPPs fall shortin performance and cannot process data at wire rates.

On the contrary, dedicated ASICsare designed to process packets at wire rates, however are not flexible. Hardwired (custom) chips are difficult and expensive to modify, to add features, fix bugs or adapt to the rapidly changing IDS features. Moreover, ASICs require massive product volumes to amortize their high NRE cost (non-recurring expenses). In order to provide the required IDS flexibility and update IDS ruleset, ASICs are forced to follow memory-based designs where the contents of an IDS rule are compiled into memory contents

that may indicate payload patterns or states of an FSM-like engine. This memory-based architecture restricts the design alternatives and limits performance. Systems' performance is restricted by the memory which, at best, may require a single access per operation and in other cases multiple accesses. Although ASICs are currently the fastest implementation platform for IDS, their performance is not as high as it could be expected compared to e.g., reconfigurable hardware. Itcan be presumed thatreconfigurable platforms are about 5-10x slower than ASICs in absolute operating frequency, since current FPGAs can operate at the order of 400-500 MHz, while ASICs at 2-4 GHz.

Network processors (NP) combine the GPP flexibility including one or multiple microprocessors and employ dedicated blocks for network functions such as packet classification and memory management in order to improve performance. The NP architectures can be also viewed as powerful GPPs or programmable engines combined with application-specific, fixed-function coprocessors. Current NPs are not prepared for IDS processing and in particular content inspection. Such functions need to be processed in the NP microprocessor(s) and, therefore, inherit the GPP performance limitations. As a consequence, new content inspection coprocessors/modules need to be designed. They need to somehow provide flexibility in order to update the IDS rules. This can be achieved by either using fixed-function, memory-based modules (as in ASICs) or seek the required flexibility in a different technology and/or implementation platform.

Reconfigurable Technology may be the answer to the above flexibility. In this thesis, reconfigurable hardware is proposed as a solution for both IDS flexibility and performance. However, this does not imply that an intrusion detection system should be entirely built with reconfigurable logic. Several parts of the system can be fixed-function or reprogrammable (e.g., microprocessor, GPP, ALU) instead of reconfigurable. To explain the difference between reprogrammable and reconfigurable, a reconfigurable device can support directly in hardware arbitrary functions on demand, while a reprogrammable device can choose only between its predefined (and committed at fabrication), finite number of functions. Reconfigurable hardware has the flexibility to update its functionality on demand and can support high performance. It achieves worse performance than an ASIC, yet not as much as expected. Furthermore, it is less flexible than GPPs (software), but still flexible enough to update the IDS rulesets.

The difference inflexibility between software and reconfigurable hardware lies in the speed of changing the functionality; not considering the time to develop the software program or hardware design. Currently, software can change its functionality substantially faster than hardware can be reconfigured. This permits to dynamically call in software a different function per packet, while in reconfigurable hardware we can only change functionality per IDS ruleset. That is, in software, based on the packet classification each packet may need only a (different) subset of rules to be checked, changing the executed routine (functionality) from packet to packet. Obviously the routines of all IDS rules need to be available in the memory hierarchy, however, only the necessary ones are executed. On the contrary, current reconfiguration times do not allow something similar in FPGAs. The hardware of every IDS rule needs to be "installed" in the device and process every packet. The available reconfigurable devices cannot be reconfigured for each incoming packet, they can however update (statically, before the IDS execution) the implemented rules whenever a new ruleset is released. In order to allow the software properties described above, reconfigurable technologies would require finer-grain reconfiguration area and higher reconfiguration speeds. FPGA technologies such as Xilinx allow partial (dynamic) reconfiguration of areas which may span the en tire length of a device and a fraction of one column requiring a few msecs[9]. This is prohibitive for per-packet reconfiguration.

It may be sufficient to update the reconfigurable parts of an IDS system (content inspection part, packet classification part, etc.) each time a new ruleset is released, however, this would require a fast design and implementation flow. A new ruleset is released every few weeks and needs to be installed relatively fast. Consequently, it is inefficient to implement a new design manually each time. Automatic design generators would be more efficient to output a new design ready to be implemented and downloaded in the FPGA device. This speeds up the process of having a new design for every new ruleset and leaves the implementation of the design (Synthesis, Place & Route) being the main bottleneck of the process. Several solutions can be envisioned to speed up the implementation phase of a design, such as patches of additional rules installed via dynamic partial reconfiguration, incremental implementation flow, and implementation guide files. Currently, the implementation phase of a complete design takes a few hours.

It is worth noting that a first attempt to design a complete reconfigurable IDS is SIFT, proposed in [10]. However, the system is used to process only parts of incoming traffic requiring a subsequent GPP to run Snort IDS and possibly being vulnerable to DoS attacks. SIFT puts together in a brute force way string matching and header matching without any attempt to reduce the overall processing load and optimize at the rule-level such as the one proposed here. Therefore, each packet needs to be processed against every IDS rule.

4. Automated generation of configurations.

In order to efficiently implement this valuable quality is necessary to take additional measures, namely, to automate the process of generating configurations loaded in the FPGA [11].

In general, the process configuration for NIDS synthesis consists of the following steps (Figure 2).

First, analyzed a database of signatures of currently known attacks. In addition to the templates - sequences of the desired character - base also includes their search rules. The analysis formed the actual table of rules, and other support information structures.

Most academic research on the topic as a signature sets used database open source intrusion detection systems such as Snort, Hogwash, Bro, etc. [10 - 12].

This solution enables, on one hand, to bring the ongoing research to real life, due to the prevalence of intensive and practical use of the above systems. On the other hand, using the same sets of rules as input for easier comparison of the various methods, algorithms and solutions implemented in varying NIDS. A more detailed discussion of issues related to the use of intrusion detection systems popular open source hardware implementation on FPGA are also beyond the scope of this paper and is scheduled for publication in the following articles.

Further configurations of synthesis steps depend essentially on the recognition algorithms selected as the basis for this NIDS. They may consist of different steps and have different computational complexity and resource consumption. In general, these structures are formed at their output:

- pattern recognition scheme;
- discriminating circuit headers;
- Detector database signature rules.

At this stage also connected fixed circuit patterns other components that do not depend on the set of recognized rules [6].

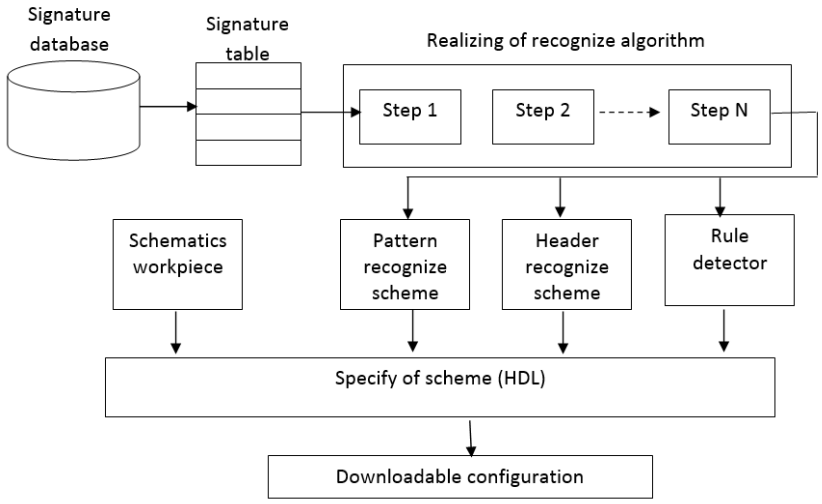

Fig.2. Configuration Steps for FPGA synthesis as part of NIDS

This solution enables, on one hand, to bring the ongoing research to real life, due to the prevalence of intensive and practical use of the above systems. On the other hand, using the same sets of rules as input for easier comparison of the various methods, algorithms and solutions implemented in varying NIDS. A more detailed discussion of issues related to the use of intrusion detection systems popular open source hardware implementation on FPGA are also beyond the scope of this paper and is scheduled for publication in the following articles.

Further, by having a structure composed specification schemes, usually at one of the hardware description languages (Hardware Description Language - HDL).

At the final stage of an existing HDL-description is synthesized by the configuration file, ready to be loaded into the FPGA. This operation can be performed either in the usual way - using proprietary CAD packages of a particular manufacturer of programmable logic chips, or with the help of special software, developed together with NIDS.

It should be noted that the process of automatic generation of a configurations for intrusion detection system also requires further study in separate publications.

5. Conclusion

Currently, the world scientific community pays great attention to the problems of creating high-performance FPGA-based IDS signature type.

As a base for experimental NIDS signatures on FPGA development in the studied most often used one of the open source database, supported by the global Internet community on the open source software rights.

In this paper we analyzed the existing world experience in developing such systems. The requirements and basic technical parameters. We describe a generalized structure of a reconfigurable network intrusion detection system. Certain essential components thereof.

Described as a generalized structure of the process automated configuration generation, loaded into the FPGA network IDS.

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Digital Transformation Research Infrastructure in Big Data and IoT Environment

Kamelia Stefanova, Valentin Kisimov

University of National and World Economy, Sofia, Bulgaria
kstefanova@unwe.bg , vkisimov@unwe.bg

Abstract. Digital transformation process is very much focused on Big data. Big data is a new philosophy that supports organizations in gathering, storing, managing, and manipulating huge amounts of data at the right speed, at the right time, to gain the right insights. The business digitization includes embedded machine sensors for improving the management efficiency, creates services-based processes and collaborative design for reaching an increased quality in short time horizons. Many organizations today realize that the traditional way they are doing the business is getting not longer effective. In order to transform the existing digital world into connected economy reality, an exhaustive research should be fulfilled in several directions, taking into consideration the business processes digitization, infrastructure technological innovations, Big data and IoT invasion. The paper suggests a functional architecture of digital transformation research in Big Data and IoT environment and 52 research services for its realisation.

Keywords. Business Processes Digitization, Digital Transformation, Business Intelligence, Big Data, IoT.

1. Introduction

Digitization of the business is a process in which ICT technologies reduce the cost of operational activities of the company/organization through the implementation of computer collaborative processing of business processes, storing, sharing and analyzing data, changing the behavior of customers and suppliers and the organization of the whole industrial connectivity.

Digitization of the businesses leads to the digitization of the economy, which is called differently - the Internet Economy, the New Economy, Web Economy, or Connected Economy, determining creating business value through digitally organized connections between people, machines and companies/organizations that introducing new business models, products and services.

The business digitization includes embedded machine sensors for improving the management efficiency, creates services-based processes and collaborative design for reaching an increased quality in short time horizons. The business digitization is approaching also the businesses readjustment to meet fast the clients' needs (through mobile applications and devices), digital production management (through intelligent connected computers and sensors, digital content and services), based on the establishment of computer platforms.

The business digitization does not work on the principle of improvement, but on the principle of creating new foundations. The digitization of a company/organization covers the following main aspects: basic ICT infrastructure of the company/organization (hardware, software, telecoms, networks, etc.) with the focus on an intelligent network infrastructure; dynamic ICT manageable business processes based on built-in intelligence in all components of the company/organization; e-business digital implementation and management of all

business processes within the company/organization; B2B and e-commerce integrating the organization computer processes with those of the client; B2C for integrating the company/organization computer processes with mobile applications of individual customers; social networks connecting the company employees themselves and with the rest of the world.

Digital transformation process is very much focused on Big data. Big data is a new philosophy that supports organizations in gathering, storing, managing, and manipulating huge amounts of data at the right speed, at the right time, to gain the right insights.

Perhaps the term sounds and could be connected to the amount of data, but this should not be the only focus. The term Big Data refers to the technology and includes processes and tools. The term "big data" includes all the types of data - structured, semi-structured and unstructured data, considering; the main data characteristics - huge amounts of data (hundreds of Petabytes and Exabytes); the large diverse of data origin (audio, video, graphics, files of the system registry, Web pages, emails, data from social networks, etc.); the high speed of data generation (every 1-2 years the data in the world is getting double), and the need to meet the critical requirement for real time processing.

2. Functional Architecture of Digital Transformation Research in Big Data and IoT environment

Many organizations today realize that the traditional way they are doing the business is getting not longer effective. They are pushed to implement modern technology and to innovate in business processes. Digital transformation turns out to become the major cornerstone for the future development and even for future organisational survival. Most of the main organizations' processes - finance, asset management, employee management, supply chain, product innovation, customer interaction, etc., should be digitized in order to make them more effective, information-driven, collaborative, and of course simple any easy to elaborate. The question appearing is how digital transformation to be accomplished.

In order to transform the existing digital world into connected economy reality, an exhaustive research should be fulfilled in several directions, taking into consideration the business processes digitization, infrastructure technological innovations, Big data and IoT invasion. The proposed functional architecture for digital transformation in Big Data and IoT environment covers an ICT complex infrastructure devoted to the following main research functionalities (fig. 1):

The proposed infrastructure consists of an integrated complex between digitized business processes and big data processing. The suggested functionality comprises of four main types of **research services**. The research services are related to the main functionalities: Services for creating digitalization strategies; Services for development of digital transformation processes; Services for ICT products selection for business processes digitization; Services for ICT infrastructural support.

Implementing an appropriate functionality for processing big data in **digitized business processes** requires research and analysis of the best international practices. This means that digitization of business processes demands advanced analysis of the world's best results in digitizing the designated business areas.

Researches should be caring out comparisons using the method of **Benchmarking**, where the desired business area for digitization (a company or particular business activity) should fulfil the main indicators achieved by the world good practices. To meet the requirements for advanced Benchmarking, the world's achievements and best practices would be updated regularly.

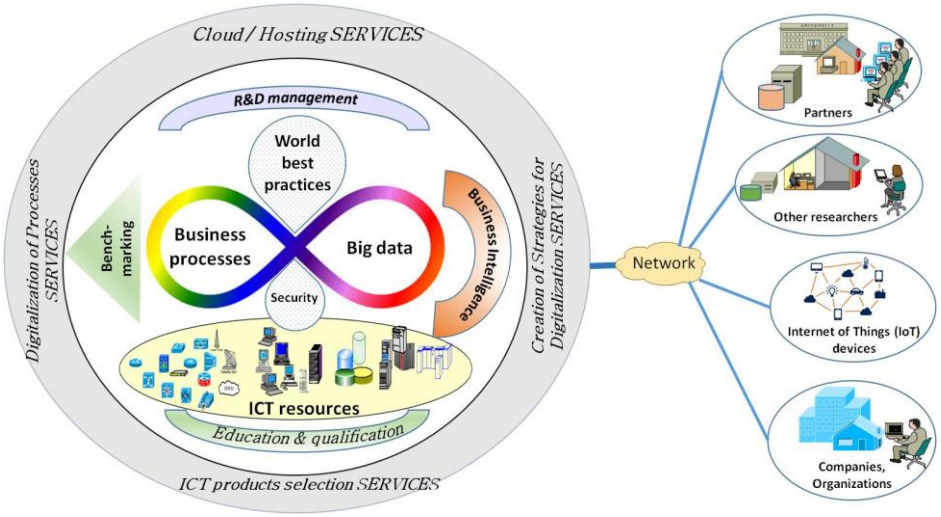

Fig. 1. Functionalities for digital transformation research in Big Data and IoT

Business intelligence should be the central component of such infrastructure because of its importance for analyzing and exploring appropriate ways for implementing big data digitization of business activities. This component is the linking part of big data from IoT collection and analysing it for the purposes of the digital transformation.

Information security is the corner stone of the infrastructure, which take place both through ICT network solutions and devices, and through methods and models that should be designed and offered in implementations of digitization, particularly in each functional aspect.

Education and training is one of the main functions in each research infrastructure. This vital component is responsible for figuring out the guiding directions in theoretical knowledge and practical experience that should be encompassed in such infrastructure to ensure its sustainability.

The proposed functional architecture would be reached by implementing technologies of the world leaders in ICT business processes digitization, of the most prominent Bulgarian leaders in the field of digitization of business, of the global leader in storing and processing of big data infrastructure - Cloudera-Hadoop, of the world's leaders of open source software for management of ICT infrastructure, of systems for processing documents with open source (CMS), of world leaders for open source databases and the unlimited amount of big data and world leaders in computer networks and information security.

3. Digital transformation research services

The proposed digital transformation research infrastructure will not only encompass technology for supporting the research, but will also build methods and tools for research processes management.

The digital transformation research will be realized by 52 research services, grouped in two main categories: Research services – 30 and System science-application services - 22.

The Research services could be classified in four main groups:

- Services for creating digitization strategies - include the creation of strategies developing the creation, expansion or innovative digitization of business of a company or organization: Strategy for digital transformation; Strategy for digitization as a critical direction

for development; Conceptual budget for a digitization project; Directions digitization expansion; Analysis and comparison of the best international and national practices for business processes subject to digitization; Development of KPIs for a business subject to digitization; Benchmarking of digitized business processes; Creation of new curricula, covering innovative digital business processes and data.

- Services for development of digital transformation processes - Determination of corporate functions and processes subject to digitization; Evaluation of the corporate digital culture and the complexity of the existing technological infrastructure; Determining the required corporate digitization level - digitization for development of the existing digital business processes, digitization by creating new digital business processes and digitization by introduction innovative solutions; Modelling and design of business processes subject to digitization; Design and modelling of business processes, subject to digitization, that the processes components are business objects and business events; Creating transformation models for IoT data and further processing; Creating transformation models for semi-structured data in structured data such as emails, web pages, office documents, etc.; Creating new and modifying existing data for innovative digital processing in particular business area; Creating new and modifying existing processes to innovative digital transformation in particular business area; Creating and discovering new knowledge for Web economy in the business area subject to intensive digitization; Construction of models for building structured data from semi-structured data based on Text mining technologies; Construction of models for building structured data from semi-structured data based on Web mining technologies.
- Services for ICT products selection for business processes digitization - Selection of potential hardware and software technologies for digital transformation; Selection of a model for developing ICT solution digitization - in-house, hosted or via cloud technologies; Selection of internal corporate resources or potential companies to implement and maintain the selected technologies; Determination of specific computer applications or computer systems for business processes transformation; Development of Critical Success Factors of the ICT solution for digitizing and designing a monitoring model; Remote connection to Hadoop and RDBMS component to the centralized research system; Prototype design of a reference architecture for working with big data - Lambda architecture, including parameters for Batch processing, Real-time processing, Query processing, Batch views, Real-time views, Integration services architecture, Database services architecture, Big data services architecture, Application services architecture.
- Services for ICT infrastructural support - Creating an exhaustive research environment by collecting sample data (structured and unstructured) associated with particular business area; Development of methods and models for determine the typical patterns of structured and unstructured data.

The System science-application services could be presented in the following list:

- Creation of methods and models for big data analysis;
- Design and implementation of Integrated Distributed Systems for Big Data working with remote Hadoop big data repositories and remote relational databases;
- Design of scalable hardware Hadoop system configurations with volumes of 100s and 1000s Petabytes;
- Design and development of prototyping methodologies for processing typical for big data structured, semi-structured and unstructured data;
- Integration of big data to digital business processes;
- Designing of corporate computer solutions for digitization;
- Comparative analysis of applications working with big data in various hardware configurations of Hadoop infrastructure;

- Design of Open Source Systems oriented to big data for Content processing;
- Interfaces design for digital business processing systems working with content processing systems for unstructured data;
- Development of application models for processing big unstructured data in content processing systems environments;
- Methods for applying instruments of Computer Linguistics to the business processes digitization;
- Development of methods for predictive analysis to support particular business areas;
- Comparative analysis of effectiveness and applicability of commercial business intelligent systems and those with open source related to concrete business areas;
- Feasibility study of the communication speed impact in centralized Hadoop infrastructures for processing big data;
- Feasibility study of the communication speed impact in distributed Hadoop infrastructures for processing big data;
- Designing methods and programming models for the input, storage and transmission of data from / to IoT devices;
- Developing principles for using the IoT data in various digital business processes;
- Designing a system for processing big data using In-Memory Microsoft SQL Server and Hadoop system;
- Research and design of semi-structured and unstructured data transformation using Microsoft SQL Server;
- Integrating Hadoop distributed system of a research user / organization to the suggested Research Infrastructure;
- Integration of Distributed RDBMS of a research user / organization to the suggested Research Infrastructure;
- Creation of innovative digital business processes with agile and automatically generated prototype.

The listed above services cover all the functionalities suggested within the digital transformation research architecture in Big Data and IoT environment.

Companies today need to innovate and update the ways they do the business. Organisations are expected to meet the main challenges of ensuring that their regulations are modernised, customers are satisfied, costs are within the projected limits, market share is expanding, etc. The organisations' management knows that old processes, policies, and products could not give them a competitive advantage. They do realize the need for digital transformation and are looking for the advanced ways of implementing it. Most organisations would not afford doing research themselves and would rely on an innovative research infrastructure that they could appropriately use.

4. Conceptual Model of Digitized Business Processes Data Repository Based on Big Data and IoT

The main challenge for developing an environment encompassing big data and IoT is the collection, integration, storage and use of non heterogeneous data that comes from many difference sources in many different formats.

This topic presents a model referring to the different formats of data within the big data and suggests the way they to be organized in a data repository for further processing according to the business processes management needs.

Traditionally, digitized business processes work with structured data organised in relational databases. Processing such data is managed by a relational database management

system (RDBMS). Transferring and using a part of the big data that is in a structured format is not a problem for the RDBMS.

Another, but relatively big part of big data - semi-structured data should be transformed into structured using two possible technologies - Text mining and Web mining, then being loaded for further processing into the RDBMS. For reaching optimal results, the RDBMS should be able to work in near real time (within seconds) these huge volumes of data (tables with dimensions of 100-1000 billions of rows).

The main suggested component of the conceptual model is the use of new RDBMS type – such working in memory with two formats of relational data - Format in rows and Format in columns, called for the paper "In memory RDBMS" - Fig. 2.

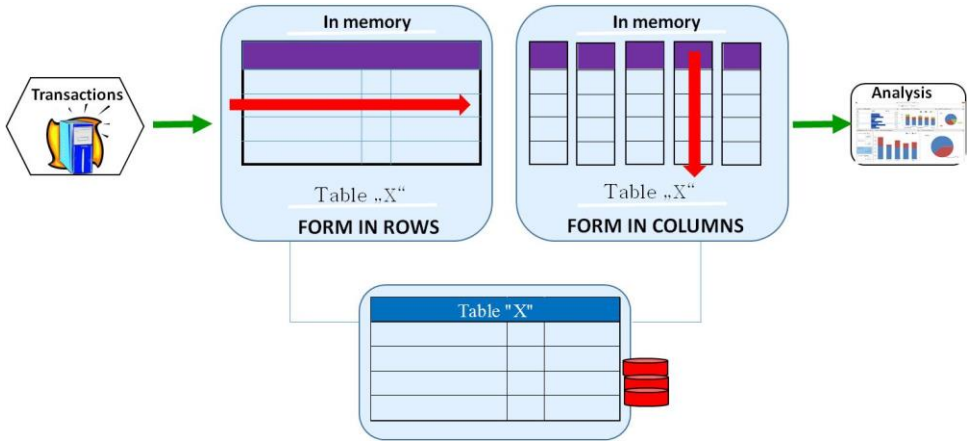

Fig. 2. In memory RDBMS

The traditional and the majority of RDBMS work only in format in rows. To ensure reaching fast digital business processes work with data from "big data" type, the model introduces operations with the same data, but in the form of columns (in compressed form), eliminating the need for indexes and providing high performance and access to huge data.

To reach this solution, the RAM should be expanded in the supported server types. The proposed model should be realised with in-memory RDBMS. Typical for In-memory RDBMS is the ability to operate with data located in a Hadoop system using devoted connectors to Hadoop.

5. Conclusion

In order to approach correctly building the Digital Transformation Strategy, organizations first should well understand what Big Data is and how this data could be incorporated within the business processes that are supposed to be digitized. The traditional data management ways could not deliver solutions on how knowledge could be extracted from so much information in so many different forms. It appears obvious the need to introduce new approaches and technologies in order to manage the data differently.

Digital transformation requires modernization of the business processes, collecting the correct information, processing and distributing it to effectively empower the employees, and satisfy customers. But how the digital transformation process to be organisationally designed and implemented. Such knowledge and experience are very critical to the average organisation to be afforded. In support of digital business transformation organisational processes, this

paper suggests a dedicated functional architecture of digital transformation research in Big Data and IoT environment and introduces 52 research services for leading the organizations in their innovation and digital transformation initiatives.

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SWOT Analysis of Cloud Backup

Emil Denchev

UNWE, Sofia, Bulgaria
emild@unwe.bg

Abstract. The paper was carried out a SWOT analysis of the possibilities for cloud backup – OneDrive, Dropbox, Google Drive, JustCloud, 4shared and Backblaze**.** Discussed the strengths and weaknesses, opportunity and threats to this modern information technology based on the Internet. Emphasis is on the use of "good" practices and effective protection.

Keywords. SWOT analysis, Backup, Synchronize, Get a link, Share.

1. Introduction

"Cloud" services (Cloud Computing) are installed on a web server maintained by the service provider and the access is done through a web browser or mobile applications.

"Cloud" services allow users to easily and securely access, store, process, synchronize and share computing resources across the Internet through a variety of devices such as PCs, smart phones, tablets, PDA (Personal Digital Assistant) devices, television and more.

According to experts from the consulting firm Protiviti "the advantages of the cloud model are obvious - companies save up to 60 % of their expenditure on IT infrastructure." [1]

2. SWOT analysis

SWOT analysis is a method to assess the Strengths and the Weaknesses, the Opportunities and the Threats available in the "cloud" Backup as a Services (BaaS).

Under analysis are both internal and external factors in order to achieve the goals of the organization.

Strengths

Functionality

BaaS allow you to store and process any kind of content, just as it is done on the hard drive - from text documents to music and video files. Some services allow you to store emails, contacts and e-calendar. Services allow accessing, editing and sharing content, no matter what platform, desktop or laptop, smart phone or tablet is used. Other important feature is synchronizing files and folders from all devices. Sharing is protected by the usage of passwords and encrypted files.

Mobile Access

One of the biggest advantages of BaaS can be the access from different devices. Regardless of the device and the location - service (at work) or personal computer (at home), smart phone or tablet (on the fly), cloud services allow you to use certain content across a large number of applications and browsers for mobile devices.

Ease of use

Mobile applications and browsers that allow the use of BaaS are intuitive and has user-friendly interface. Mobile applications are easy to be configured and to be setup for the needs

of each customer. What remains to be done are only local settings through predefined templates.

Help and Support

Get help with a problem when using the BaaS through communication with a telephone, via email or chat. The service provides a forum and other information materials as well as the services of highly qualified and experienced IT professionals.

Maintenance, including updating and upgrading the content of the services is performed by the supplier. This saves time and costs, as for example in business information systems, where the process of updating and upgrading is a complex and expensive process.

Reduced costs

The use of BaaS reduces the costs associated with the purchase of hardware, software, room hire and qualified staff to care for their maintenance. Companies pay only services ordered and used, i.e. customers pay a monthly fee and are not required to purchase expensive licenses. The time required for analysis and management of IT resources is diverted to key business activities.

Example: since no investments are required in ICT infrastructure disk storage system for archives (back up) with a high degree of reliability and performance can be provided. The prices and the complexity of backup and archiving models increase in proportion to the amount and the importance of the data.

Flexibility

The provider of a BaaS offers the ability to change at any time the necessary IT resources to respond to a change (growth or decline) in the business environment;

Weaknesses

User data is not on the local disk

If there is no Internet access - obvious lack of easily and quickly accessible data from backup is a serious problem.

Apply different security policies

Ordinary security policies on the local system are different from the security policies of the provider of BaaS. This means that the created users in the Local Active Directory are not automatically created in the "cloud" application, passwords are managed separately and there is no centralized monitoring of logs (log security).

Difference in functionality offered

BaaS applications may have different functionality (more or less) than the one offered by local applications. This can lead to the presence of "excess" functions or to certain limitations in the operation and utilization of the application.

Opportunities

Backup as a Service (BaaS) includes:

1. Maintenance Web storage and content – creating folders, upload, copy, move, rename, delete folders and files, download file(s),
2. Sharing the content with other users and different user rights – can edit, can view,
3. Generating a link for access anywhere from blog or web page,
4. Synchronizing web structure with local structure,
5. Security transferring and store data by modern encryption technologies;

Threats

To consumers of Backup as a Services there are certain threats mostly related to security.

• In many of the BaaS developers do not comply with modern encryption protocol that protects data from unauthorized access. Various mobile applications have different levels of protection - as well as the level of security and in response to new attacks.

• Vendors are developing new updates for mobile applications, and new mobile applications to reduce risks and make their services more secure, but this requires downloading and installing these applications, which carries risks of viruses. In the future it is expected that BaaS will provide a unified solution that will increase protection against attacks.

3. Comparative analysis

Analyzed are the following BaaS:

1) OneDrive,
2) Dropbox,
3) Google Drive,
4) JustCloud,
5) 4shared,
6) Backblaze;

BaaS	Free web storage	Two way Synchronize	Incremental backup	Security	Task scheduling
OneDrive	5 GB	Yes	No	SSL (https), Sookasa	No
Dropbox	2 GB	Yes	No	SSL, AES-256 bit	No
Google Drive	15 GB	Yes	No	SSL, AES-128 bit	No
JustCloud	1 GB	No	No	Data centre	Yes
4shared	15 GB	No	No	AES-128 bit	Yes
Backblaze	No	No for deleted files	Yes	SSL, AES-128 bit	No

4. Conclusion

Benefits of on-line archiving:

1) Option for creating archiving schedules,

2) One-time setup, after which it works in the background, as the archiving is being executed automatically,

3) Better security and protection of information is achieved, with compression and encryption of information, before it leaves the client's computer, via algorithms for encryption (for example the 128 and 256 bit encryption), protected channels for internet connection(https)

and security protocols (SSL – Secure Socket Layers), storage of the archives in modern technological centers of professional and protected. The authentication traffic of the user, by username and password is also encrypted, and the administrators don't have access to the user passwords,

4) Higher efficiency – as only information is being archived and compressed, be it newly created or changed, it's volume is. This way there is no additional strain on the net traffic, no added web disc space is being taken and costs for storage of the archive are reduced as you pay for volume stored information,

5) Availability for web access for the scheme 7/24 (7 days in the week and 24 hours in the day) – upload of the backup from every workplace, connected to internet with possibility of downloading and restoring the information, and the only requirement is an internet browser (Microsoft Edge, Internet Explorer, Mozilla Firefox, Opera etc.),

6) Option of sharing the archives over internet with other users – granting access to specific files from the archive to other users, or groups with specified permissions. Team work is realized in this manner, each and every one of the users has access to up to date information,

7) The used software is of the client-server type, used as a client's application, placed on the computer and on a web-based part. The client's program provides the basic functions for archive recovery, while the web-based – recovery of a specific version of information (to a specific date), sharing the files with other users, sending a link for downloading of archives via e-mail and more,

8) Installing and configuring of the software is eased to the maximum, as the most important folders and files are selected for archiving, including business information, papers, offers, mail , contacts and more,

9) Doing regular maintenance of the "history" of archives is possible for creation and maintenance of different versions of files at different times, option for recovery of older versions, to previous periods of time, including the deleted files from discs of the local computers,

10) Usage of a unified plan – you pay for volume (in GB) stored information, regardless of the amount of users and used computers, option for automatic tracking and deduction of monthly payment, and via usage of systems for online payments, Bulgarian or international, like ePay, PayPal and many more. Practice shows many examples of cloud deployment for data backup and network management, such as those described in [7, 8], and many others.

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Restructuring of the Global Economy under the Impact of New Technologies

Maya Tsoklinova

University of Forestry, Sofia, Bulgaria
malenna85@yahoo.com

Abstract. The main objective of the research report is to analyze the restructuring of the economy under the impact of new technologies. Special emphasis is placed with respect to their impact on income distribution; rapid productivity growth; improving the qualification of the human factor; the emergence of new energy sources, the development of relevant scientific fields such as genomics and nanotechnology that support and develop a range of industries, including healthcare, energy and agriculture. The research interest is focused on analyzing the changes that new technologies cause on both developed and emerging markets.

Keywords. Restructuring, economic impact, new technologies, income distribution, productivity growth.

1. Introduction

Modern society is developing under the influence of new technologies that change completely its economic behaviour. Digital technologies (information and communication technologies - ICTs) are defined by a number of researchers as a general purpose technologies. General purpose technologies not only provide new products, but change everything: the nomenclature and assortment of goods, their production, and organisation and management, the necessary production infrastructure, laws and regulations related to their commercialization, and the nature of work. Through last years a whole range of new products have been produced: kitchen appliances; portable power tools; new entertainment and information products such as film, radio and television; electrical output motors and control systems of machines and vehicles.

2. New technologies and innovations

Digital technology continue its evolution as enrichment and development information market through the creation of new machines in the form of a laptop, tablet, smart phone, digital camera and GPS system, virtual reality and 3D printing. They have new processes (software applications) that improve performance by connecting and transmitting messages from a distance [1]. These technologies lead to a complete transformation of the factories, offices and housing. Today, the smart phone is "new office". Some researchers argue that digital technologies have not so strong influence, that electricity had, especially since electricity is reconciled with other technologies such as internal combustion engine and mass production. Table 1 describes new technologies and presented their prospects in the next decade.

New technologies stimulate a wave of new investments. If these technologies bring a necessary products or processes that reduce costs, business investment could help companies quickly respond to new opportunities ahead. In the 40s of the last century economist Joseph

Schumpeter has popularized the idea of "creative destruction", which he describes as "an essential fact about capitalism" [8]. In his view, innovation waves cause creative destruction process that generates long cycles of economic activity. The strongest impetus coming if the technology requires associated infrastructure such as the electricity needed for generating stations and power lines, while cars require roads and petrol stations. Digital technologies stimulate infrastructure costs for cabling, satellites, telephone poles and servers.

Table 1. Innovations in ICT in the last 30 years

Hardware	Software	Business processes
PC	Spreadsheets	Information websites
Laptops	Word processing	E-commerce
Tablets	Presentation	Internal admin systems
Mobile phones	Email	Logistics tracking
Smart phones	SMS	Customer booking systems
Digital cameras	GPS	Accounting systems
Scanners	Social networking	Security systems
Automation of machines	Media file compression	Working from home
Self-service ATMs	Bar codes	E-payment
Smart home appliance	VPN	E-learning
Drones	NFC	Bitcoin

Source: Author interpretation of Standard Chartered Research

It is known that new technologies encourage new waves of investment, which should not necessarily be sudden turns and goes with an investment surge in 2016 - 2017, this may take longer. Furthermore, as the cost of computing power decreased so rapidly, the scale of investment that are required cannot be so great. New technologies are relatively small and inexpensive items such as chips, smart phones, 3D printers and even robots than large elements of the past such as cars, wind turbines and containers for transportation. As previously are established technology, the more productivity, materials and energy are required [3].

For business low cost of investment in new technologies is worrying because it implies low barriers to entry. It is necessary to mention that new technologies are devastating for obsolete products, processes and services but also they are established relatively quickly and easily. For small and start-ups firms as well as for companies in developing countries that often have less access to capital, it is a good opportunity. Thus it may stimulate faster productivity growth, albeit with potential consequences for jobs

3. Growth and productivity

Some observers believe that new technologies stimulate productivity growth. The exponential nature of improved digital technology such as computer power doubles every 18 months i.e. and the cost of reproduction of digital information and software are essentially zero.

Remains controversial thesis that growth and productivity depend on new technologies. Many researchers in this field cannot find common ground. Robert Gordon from North-western University that explores productivity and growth throughout his career, is perhaps the most famous sceptic on this topic (Gordon, 2012). Gordon sometimes characterized pessimistic technology, although this is unfair. He notes that the US has enjoyed much faster productivity growth from 1920 to mid-1970 and that productivity growth has been slower since the 70s of the last century (see. Table 2).

Table 2. Improvement of living standard through the period 1870 - 2010

Period	Total factor productivity (average annual growth rate)	Source of growth
1870 - 1900	1.5 % - 2 %	Transportation, communications, trade, business organization, X-ray,
1900 - 1920	1 %	Improvement of materials, Automobile production
1920s	2 %	Electricity, internal combustion engines, chemicals, telecommunications, medical inventions
1930s	3 %	Civil engineering,
1940s	2.5 %	Nuclear power, computer
1950 - 1973	2 %	Cars adoption, consumer durables, telephones, plastics, air travel
1973 - 1990	< 1 %	Optical discs, Video camera,
1990s	> 1 %	Personal computers, Internet, E-mails
2000s	1.5 %	Engine search, mp 3 player, mobile devices
2010s	1.5 %	Social network, Wi-Fi technologies, sensor interfaces

Source: Shackelton, 2013, Standard Chartered Research

This phenomenon in the period after 1970 Robert Gordon as a "return to normalcy" after extraordinary gains from newly discovered electricity, internal combustion engines and phones. He admits that there are gains from new technology, but it is doubtful they can be compared with those reported in the 20th century and the impact they have on humanity. Moreover, the benefits of digital technology is already associated with the transformation of lifestyle-induced PC and Internet use since 1980. Gordon believes that productivity growth reached its low rates since 2008.

There is some evidence that the initial impact of new technology generates lower productivity growth. In the US, the electrification of factories began in the 20th century, but productivity growth is low in the beginning. Productivity growth increases only when factories decide on the potential for a much smaller engines for each machine. This makes assembly line used most effectively by the company "Ford" at the beginning of last century. Assembly line using electrically powered machines quickly transform production [7].

Productivity growth in developed countries is unusually slow in recent years, which is not a good situation. Cyclical factors such as low capacity utilization, weak investment activity or reducing salaries, represent real reasons for the difficult economic situation. In this vein, the slower productivity growth could reflect the growing legal regulation on environmental measures to increase the safety of working time (which is associated with public benefit), but reflected in lower productivity [5].

High energy prices also can be part of the causes of slow productivity growth. The last time, in developed economies, productivity growth fell sharply in 1970, after the shock in fuel. This period is associated with a deep recession and weak economic growth. Still, test new

technologies lies in whether they can grow fast enough to become a key prerequisite for generating greater productivity.

4. Total factor productivity and labour productivity

The growth of total factor productivity (TFP) is the additional growth of the economy as it is achieved not only with increased hours of work, improved skills and qualifications or availability of more capital (called capital deepening). It is believed that the growth of total factor productivity due to the overall technological progress and includes better organization, management, logistics, and the introduction of new machines and technologies. The level of the tech achievements, as measured by the Achievement Index is closely related to the overall level of income [3].

The growth of labour productivity is the change in productivity per hour worked and includes profit from TFP and profits due to higher skills and more embedded machines. It is a good measure of technology adoption, especially for developing countries. Using more machines (i.e. the development of so-called Deepening capital), skills training and retraining is the mechanism by which existing technologies are able to be distributed [7].

4.1.Consumer surplus

Consumers (or businesses) do not buy goods unless the benefits for them are not equal or exceed the cost of their acquisition. This surplus value is called consumer surplus. It is to add to GDP, to assess the value of new products or technologies. This concept applies to all products and services, but since many of the latest technological products and services are software whose cost of reproduction is essentially zero, it is possible consumer surplus generated by new technologies to be higher than traditional products.

4.2. Employment and income distribution - a threat to jobs

If the new technologies lead to increased growth of total factor productivity and labour productivity, it should be welcomed. Faster GDP growth means more money for everything - including consumer goods, education, health and pollution control. Thus, it is easier to mitigate inequality, as with faster growth is more likely that everyone enjoys a higher standard of living over time, even if some groups have more than others [2]. Despite growing fears that new technologies can reduce the number of jobs (especially routine jobs), mainly economists reject the fallacy of the so-called "table work", i.e. the idea that the required workload is fixed, technological change or immigration will put people out of work permanently. It is necessary to take account of the fact that humanity lives by the rapid development of technology in the past 200 years, leading to erosion or disappearance of many jobs and inevitable economic cycles [7]. Furthermore, as a whole, new jobs tend to be better paid, safe and enjoyable. In many cases they are related to new technologies.

5. New Digital Technology

In the 80s of the last century, computers are distributed across developed countries and lead to different transformations in a number of economic sectors. Over the last decade, digital technologies are becoming more computing power and appeared mobile and cloud technologies. So-called Web 2.0 technologies relate to sites that allow users to collaborate and interact to create user-generated content. Activities such as social networks, blogs, video-sharing, tagging and compilations transform the way people spend time and interact, compared to static websites [6]. Development of ICT-based technologies help improve range of technologies through improved computer control systems using cloud services or improved

research methods such as computer simulation. All this is a reflection of the internal dynamics of the ever-evolving technology in other areas.

5.1. Energy

Research and development in the energy sector received a huge boost from high fuel prices over the last decade, and the government's efforts to reduce carbon emissions. In 2009, the US began to plan the use of liquid natural gas terminals to import natural gas. Currently, permits are issued for the export terminals due to that sudden expansion of oil production plays a significant role in this over-marketing. Renewable energy sources, including wind and solar power and biomass also represent a significant step forward by reducing costs and improving technology. Hybrid engines and electric vehicles are being developed constantly, leading to a drastic reduction in the consumption of fossil fuels for vehicles. One key area of research are technology batteries, as improvements could make electric vehicles more attractive and used [6]. These improvements lead to support investment in intermittent renewable energy sources such as wind and sun. There have been improvements in the railway transport industry.

All these examples are clear evidence of the impact of new technologies on a number of significant industries. This means that the high cost of energy in many developed countries stimulate government decisions be directed to use of cleaner energy sources (through subsidies or higher consumer prices), but also leads to significant costs for the economy over the last decade and possibly negatively affects productivity growth. After all, energy is the key to everything. If there is sufficient energy at a lower price without negative consequences for the environment, many problems would be decided easier.

5.2. Genomics and other digital technologies

Life in the form of DNA can be quantified. In the long run this means that digital and biological technologies can merge. This means that advances in computing power is transformed into genomics, which has important implications for health and agriculture. In particular, the cost of sequencing DNA have decreased significantly - from 100 million USD in 2001 to several thousand dollars now. Genetic variations are associated with a number of conditions, including cardiovascular disease, cancer, schizophrenia and Alzheimer's disease. The next step is to develop treatments based on the genome of the individual. For example, at the time of cancer patients are often given a cocktail of five or more different drugs. Each may represent a cure for some patients, but there is no way to know who will work for each individual patient [4]. Knowing this will save money and also will reduce adverse reactions.

Genomics has important applications in agriculture. Genetic engineering or genetic modification controversial in Europe and China, but are routine in North America. Many researchers in this field believe that it will help increase the amount of food globally, in order to meet growing global needs. In addition, it is expected and improve nutrition by the addition of vitamins or minerals or other ingredients in improved production cultures. The economic impact of genomics is difficult to assess. In agriculture could lead to a significant increase yields and reduce labour and energy costs. In healthcare there is an argument that new treatments mainly enrich existing old who often already applied less frequently and so the effect will be an increase in health care costs and pension requirements without increasing productivity [9].

5.3. Nanotechnology

Nanotechnology refers to techniques for manipulating research level atoms or molecules i.e. much smaller than normal. The materials which are used in nanotechnology often have better properties compared to conventional materials and are lighter having the same functionality [4]. Nanotechnology is expected to enable improvements in a wide range of products and processes, including new materials, advanced manufacturing techniques, including the use of less material, but different processes, new methods of water purification, and improve food production.

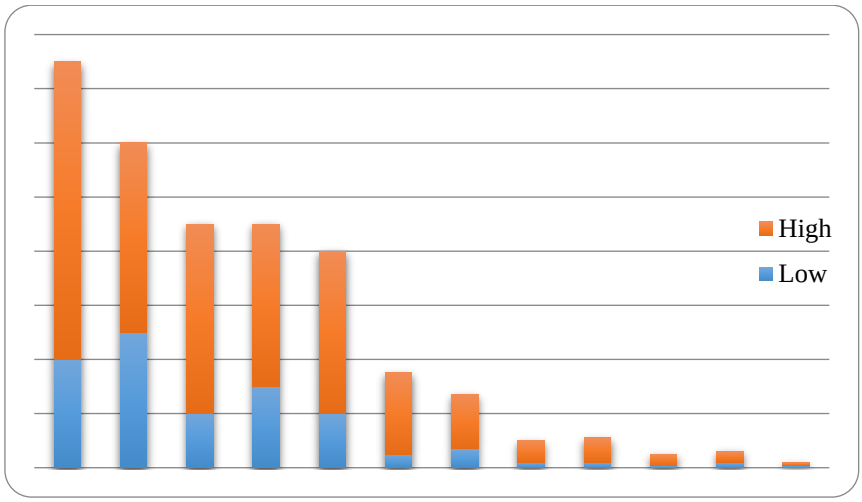

Fig.1 . McKinsey estimates for the impact of the new technologies
Source: McKinsey, 2013

5.4. New technologies and sustainable development

There are serious concerns about the impact of new technologies on sustainable development. Technology leads to growth (which implies greater use of resources), extra energy use and expansion of income distribution. These countries are now distributed very unevenly. This applies mostly to a large group of people who have access to computers, although this is changing rapidly through the penetration of smart phones in people's lives. Network society affects organizations with public or private interest over the management policies of social and economic processes, contributing to the creation of a new institutional environment at national and regional level [5]. It could say that this society is based on technology and computer networks exist through them. At the same time it is characterized by a kind of cycle of inner transformations caused by the specifics of applied technologies. Ultimately, the impetus from the emergence of computer-based information technology breeds a new virtual community that generates its own secondary waves for periodic renewal and development.

6. Conclusion

It could make the summary that the previous temporal and spatial constraints to some extent already have been overcome. Working in a computerized network environment is a daily practice (e.g. through the facilities and services of Internet). World Wide Web represents technical and program provided universal background for communication between people.

The most important question to resolve is to find an appropriate methodology to assess the extent of the impact of globalization on technical part of the industry and the contribution of new technologies on productivity and growth. Along with this global economic problem it is necessary to concentrate efforts on the efficient and sustainable functioning of global markets, products of interaction between technical globalization and regionalization resource.

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Factors Determining Individual Consumption Expenditures by Households in Bulgaria

Konstantin Kolev, Maya Tsoklinova

University of Forestry, Sofia, Bulgaria
konstantinklv@yahoo.com , malenna85@yahoo.com

Abstract. On the basis of consumer theory are outlined the factors that determine the individual consumption expenditures by households and multiple regression model is specified. By means of the method of ordinary least squares the regression coefficients are estimated and some conclusions about the influence of the independent variables upon the dependent variable are drawn up.

Keywords. Multiple regression analysis, Individual consumption expenditures, Price levels.

1. Introduction

Household consumption expenditures are essential for the economy: first, it is the largest component of GDP and because of that can contribute to high degree for the increase of GDP; second, it can be used as an indicator for the standard of living and level of economic development. Concerning the last one, it should be mentioned that households make up a stereotype of behavior, which is expressed in striving to raise their living standard in long run period and maintain a relatively constant set of goods and services in the short term. This provides stability for both individual households and economy as a whole [1]. Because of that it is necessary to identify the key factors determining consumer's behavior and to estimate the extent of their impact. Due to this the **purpose** of this study is to specify a model of consumer function at national level.

The study of literature sources [1, 2, 3, 4, 5, 7, 8] gives us ground to sum up that the determinants of consumption expenditures by household are: income, interest rates, price levels, savings and taxes.

2. Collecting the Data

All data are for Bulgaria for the period 1999-2015. They are presented in table 1. As **dependent variable** is used Individual consumption expenditures by households (ICE). The data are collected by National Statistical Institute (NSI).

The independent variables (regressors) are:

- Annual Money Income of Households (AMI). The source of the data is National Statistical Institute (NSI). The relation between the income and individual consumption expenditures should be positive, i.e. the increase in income should leads to increase in consumption expenditures;
- As indicator of price levels is used the rate of inflation (RI). The source of the data is again NSI. When the prices increase it is logical the consumption expenditures on national market to increase as consumers maintain a relatively constant set of goods and services, which prices become higher. So the relation should be positive.

- The third factor, which is supposed to impact the consumption expenditures, is interest rate on consumer loans (IRL). The source of this variable is Bulgarian National Bank (BNB). The relation between IRL and ICE is negative. The lower is the interest rate the higher are consumption expenditures.
- The fourth independent variable in the model is the revenues from taxes and social securities (RTS). The source of the data is the Ministry of Finance. Since the taxes reduce personal income, this will reduce purchasing power and from here the individual consumption expenditures of households. So the relation between the two variables should be negative.
- The last independent variable is household savings (HS). The relation between HS and ICE is negative, i.e. the higher are the savings the lower are the consumption expenditures. The source of the data is BNB.

Table 1. Determinants of Individual Consumption Expenditures in Bulgaria during the period 1999-2015

Years	Individual consumption expenditures by households, millions BGN	Annual money income of households, BGN	Rate of inflation, %	Houselods savings, millions BGN	Revenues from taxes and social securities, millions BGN	Interest rate on consumer loans, %
1999	16683	3321	2.6	2915.5	7480.5	17.19
2000	18620	3530	10.3	3593.1	8707.2	17.11
2001	21181	3601	7.4	5047.3	9190.5	17.15
2002	22934	4029	5.8	5780	9596.7	16.37
2003	24641	4348	2.3	6825	11114.1	15.74
2004	27425	4725	6.1	8753	12778.5	13.86
2005	31309	5179	5.0	11302.8	14483.9	12.17
2006	34762	5863	703	13922.3	16326	10.23
2007	41301	7130	8.4	17986.3	19323.7	9.79
2008	45766	8353	12.3	21004.3	21350.5	11.16
2009	42942	8807	2.8	24339	19485.2	13.43
2010	47414	8826	2.4	27344	18308.4	12.73
2011	50026	8967	4.2	30877	19809.7	12.04
2012	53346	9829	2.9	34502	20714.5	11.67
2013	50660	10793	0.9	37699	21552.4	11.37
2014	51963	11214	-1.4	39266	22205.5	11.54
2015	54831	11415	-0.1	42586	23989.2	10.77

Sources: Bulgarian National Bank, Ministry of Finance and National Statistical Institute

3. Model Specification

Using the data from table 1. the following regression model is specified:

$$ICE_t = b_1 + b_2 AMI_t + b_3 RI_t + b_4 IRL_t + b_5 RTS_t + b_6 HS_t + u_t \quad (1)$$

The coefficients, their standard errors and p-values are presented in table 2. From there is obvious that all coefficients in front of the regressors are insignificant. The R-square of the model is high (0,9812). All these are signs of of multicollinearity.

Table 2. Coefficients, standard errors and p-values for the first model

Independent variables	Intercept	AMI	RI	IRL	RTS	HS
Coefficient	10321.21	0.0292	213.240	-205.035	1.116	0.532
Standard error	16103.75	2.921	262.432	824.729	1.132	0.384
p-value	0.534	0.992	0.434	0.808	0.345	0.193

To detect multicollinearity in table 3. the correlation among the regressors is checked. Multicollinearity is a serious problem when excess 0.8 [6]. From table 3 might be seen that RTSS and HS are the regressors that have correlation coefficients with other regressors higher than 0.8. To overcome the multicollinearity the two variables RTS and HS are dropped from the model. The new model is presented in equation (2), which is written below the table 3.

Table 3. Correlation among the regressors

Regressors	AMI	IRL	RI	RTS	HS
AMI	1.0000	-0.7469	-0.5183	**0,9590**	**0.9903**
IRL	-0.7469	1.0000	0.1259	**-0.8828**	-0.7152
RI	-0.5184	0.1259	1.0000	-0.3335	-0.5754
RTS	**0.9591**	**-0.8828**	-0.3335	1.0000	**0.9297**
HS	**0.9903**	-0.7152	-0.5754	**0.9297**	1.0000

$$ICE_t = b_1 + b_2 AMI_t + b_3 RI_t + b_4 IRL_t + u_t \quad (2)$$

LR tests for omitted variables have been applied. The variables, which have been omitted from the equation (2) are RTS and HS. The null hypothesis states: that additional set of regressors is not jointly significant, while the alternative states that they are significant. The likelihood ratio test for omitted variables is performed. From table 4. and table 5. can be seen that the F-values and LR are insignificant. Because of that the zero hypothesis is accepted, i.e. the two variables (RTS and HS) do not belong to equation (2). The model presented in equation (2) is checked for mis-specification. From the insignificant F-statistic (1, 12), which value is 0.0702 can be concluded that the model presented in equation (2) is well specified.

Table 4. Omited variable test for RTS

	Value	df	Probability
t-statistic	0.3865	12	0.7059
F-statistic	0.1494	(1, 12)	0.7059
Likelihood ratio	0.2104	1	0.6465

Table 5. Omited variable test for HS

	Value	Df	Probability
t-statistic	1.0544	12	0,3124
F-statistic	1.1119	(1, 12)	0,3124
Likelihood ratio	1.5064	1	0,2197

Finally the model presented in equation (2) is checked for autocorrelation. To detect it Durbin-Watson d test has been done. The Durbin-Watson test for autocorrelation for n=17 and k = 3 shows that $d_L = 0.897$ and $d_U = 1.710$. The computed d is 1.0887. The last one is between

d_L and d_U or $d_L \le d \le d_U$. Because of that no decision for autocorrelation is possible. In result of this LM correlation test has been done. From table 6. can be seen that Obs*R-squared for three lags included is significant, which means that alternative hypothesis is accepted, i.e. there is autocorrelation.

Table 6. Breusch-Godfrey Serial Correlation LM Test

F-statistic	4.8365	Prob. F(3, 10)	0,0248
Obs*R-squared	10.0639	Prob.Chi-Square (3)	0,0180

The problem of authocorrelation can be solved by means of the method of generalized least squares (GLS). After appropriate transformation of the original model the transformed model is received. The coefficients and the standard errors after correcting model (2) are as shown in table 7. In the corrected model all regressors are significant and R^2 is equal to 0.937.

Table 7. Coefficients, standard errors and p-values for the transformed second model

Independent variables	**Intercept**	**AMI**	**RI**	**IRL**
Coefficient	5084	3.793	152.550	-955.966
Standard error	5183.910	0.465	185.089	459.469
p-value	0.026	0.000	0.042	0.039

The Durbin-Watson test for autocorrelation for n=16 and k = 3 shows that d_L = 0.857 and d_U = 1.728. The computed d is 1.754. The last one is between d_U and 4-d_U or $d_U \le d \le 4 - d_U$. Because of that in the transformed data there is not autocorrelation (positive or negative). LM correlation test has been done also. From table 8. can be seen that Obs*R-squared for three lags included is not significant, which means that null hypothesis is accepted, i.e. there is not autocorrelation.

Table 8. Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.295	Prob. F(3, 9)	0,334
Obs*R-squared	4.826	Prob.Chi-Square (3)	0,185

4. Conclusion

The results from the research paper give grounds to be concluded that the factors which impact the individual consumption expenditures are annual money income of households, interest rate on consumer loans and rate of inflation. From the regression coefficients presented in table 7. is obvious that when the money income of households increases with 1 BGN and the influence of all other factors is hold constant the change in the mean value of individual consumption expenditures is 3.793 million BGN. The relation between interest rate on consumer loans and consumption expenditures is negative. One percent increase in the value of interest rate leads to decrease in the mean value of individual consumption expenditures with 956 million BGN when the influence of all other regressors is hold constant. On the other side the connection between rate of inflation and consumption expenditures is positive. One percent increase in the value of rate of inflation leads to increase in the mean value of

individual consumption expenditures with 152.55 million BGN when the influence of all other regressors is hold constant.

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Standardized and Statistically Sensible Evaluation Model for Technology Ventures Selection

Petko Ruskov[1], Kyungjin Hyung[2]

[1] Sofia University "St. Kliment Ohridski", Sofia, Bulgaria
petkor@fmi.uni-sofia.bg

[2] Korea Technology Finance Corporation, Korea
Dukehyung@gmail.com

Abstract. *Purpose:* this paper aims to propose a possible way to establish a standardized and statistically sensible evaluation model to select the right kind of technology ventures. *Methodology/approach*: the paper is developed following a classical methodology for research, analysis and design of a model for technology ventures selection. It starts with analyzing current situation in Bulgaria and will compare the practice with that of Korea by analyzing its venture certification practice including past performance and recent challenges. It introduces Kibo Technology Rating System (SM 2.0) in Korea for evaluating technology start-ups based on growth potential and business risk used for debt guarantee financing and certifying as 'venture'-legitimate national certificate for policy benefit. *Findings:* there is an extraordinary need for future development and improvement of the technology rating systems, providing supportive information for the Bulgarian innovative and entrepreneurial ecosystem. *Practical implications*: the paper suggests a possible way to localize such practice in better manner in the context of Bulgaria and it will also address how to best utilize the outcome of the rating for Signaling to different stakeholders in the eco system and Leading the entrepreneurs in desired direction by leveraging ICT technology. *Originality/value*: a methodology to select the right start-ups to be supported.

Keywords: technology ventures, technology rating, technology commercialization.

"Technology is like fish. The longer it stays on the shelf, the less desirable it becomes"
Andrew Heller, IBM

1. Introduction

Innovation is a backbone of a national prosperity. In the era of knowledge-based economy, *innovation* is a key driver for the economic growth. The term 'Innovation' has many different definitions despite universally shared sense of what it signifies on the surface. For this paper, innovation primarily means technology innovation in combination with business model, concepts of which are often not detachable one from the other. More precisely, innovation in this paper would refer to the applications of technology in the form of products or services to be accepted in the market.

The world is experiencing a boom in interest around entrepreneurship and intrapreneurship [1, 2]. The business ability to develop innovative products and services is important factor and strategic advantage. Business must adopt innovations from internal and external sources often in the form of technological innovations to remain competitive [21]. Frequently the key to success for a technology start-up is to validate the technology and the needs of the targeted customer.

Every nation state in the world agrees on the importance of cultivating sensible environment that would foster innovation that leads into commercialization. As a result, we are witnessing surprising level of synchronization of start-up boosting ecosystem in terms of physical environment all around the world. High tech parks, start-up incubators, and accelerators are a few to mention. Despite this astonishing similarity of hardware infrastructure among different countries, the way these physical elements and support programs are operated each country varies resulting in different performance in terms of actual GDP increase. Amongst former Soviet Union countries, Estonia seems to be doing well in the start-up hemisphere.

How to make innovation ecosystem work is a complicated agenda that requires taking a deep look at each pivotal element in the system and also at interplay between elements and with external factors such as culture and degree of corruption in general. This paper does not attempt to provide global solution to solve every problem in the innovation ecosystem in Bulgaria. Instead, it intends to introduce a successful system in Korea dynamically used as a sensible selection methodology for the right set of start-ups to be supported with various public and private resources. We believe such selection is the most crucial step for sustainable spinning of overall innovation policy.

The best case for a standardized rating system is the Robert Parker's wine rating. Robert Parker's rating system employs a 50-100 point quality scale (Parker Points®) together with his tasting notes that he uses it as primary means of communicating his judgments according to his website [5]. His rating becomes a guideline to consumers in selecting quality wine. These ratings are the excellent standard in wine ratings. Although Robert Parker uses rating system, he makes judgment by leveraging his talent and expertise which has proved its legitimacy through a long history of serving the same vocation. Wine is different from innovation because variations of wine taste are fewer than future prospects of innovation. Evaluating innovation requires significant degree of sophistication. It may still be fine or even better to rely on experts who are well-experienced and seasoned like Robert Parker in the innovative business domain as is the frequent case for the U.S. If such seasoned professionals in both technology and business are not easily employable, the usage of standardized rating system makes more sense. Besides the degree of sophistication of rating system, we need to pay attention to the motivation of Robert Parker to use rating system. The system in this case is for the benefit of communication with stakeholders, wineries, distribution channels and consumers.

The goal of the paper is to present a technology assessment and technology adoption current state and to propose a possible way to establish a standardized and statistically sensible evaluation model to select the right kind of technology ventures.

2. Situation Analysis

In U.S., the leading country in the conundrum of innovation and therefore often benchmarked by the rest of the world, there are sufficient supply of innovation consumers and investors. First of all, there is a critical mass of ‘active consumers’ who are enthusiastic enough about new ideas to early adopt them. Quite a few people are willing to experiment and pay for the newly created products or services before it is proved among majority consumers. Those early adopters also enjoy offering feedback actively as we can see from Kick-starter or IndiGoGo, crowd-funding platforms that enable early stage start-ups to test the market at prototype stage [13]. In case of innovation in the domain of B2B market, there are many global giant companies like Google, Apple, J&J and Cisco always looking for next new ideas springing from the unpredicted edges. They adopt innovation by either purchasing the new products *per se* or acquiring start-ups who created the innovation early on.

From the financing side, there are various different type of seasoned investors specializes in stage or in technology field. Their sophisticated capital market with plenty of liquidity allows those investors with high risk appetite to generate huge return in case of success. All these elements create self-reinforcing virtuous cycle to boost and sustain innovation in the U.S. shedding a lot of chances for quality market discipline. The experts are continuously generated out of the virtuous cycle and they select facilitate next innovators. *Pitching* and screening of such pitching are main means to select the right start-ups to be supported, and it works fine there.

When it comes to emerging market economy, this is not the case. First of all, there are not many proactive consumers with willingness to pay for new ideas. Capital market is not well developed so that it is difficult for investors to find exit window. There are not many serial entrepreneurs willing to remain in the home country after the first success.

Israel, a small country with small talented population, became a successful start-up nation by successfully engaging U.S. venture capitals early on through Yozma fund scheme [18] and they directed their start-ups to be listed in the U.S. capital market, NASDAQ. This is one way of solving selection problem.

Bulgaria has set pivotal elements for growing up innovation. Bulgaria has incubators and accelerators and most recently established Sofia High Tech Park. Figure 1 illustrates the author's view of the present structure of the ecosystem in Bulgaria. Sofia Tech Park serves as a hub between the academics, entrepreneurs and capital providers. However, there is not sufficient understanding of how creation and adoption of new technologies are to be transformed to propose and capture the value effectively in the market. What does achieve such an effective transformation is a business model that can link a new technology to market demand. A business model is a system whose various features interact, often in complex ways, to determine the company's success [12]. Business model is created by ventures namely startups. A system that is able to tell apart successful from unsuccessful start-ups in advance will be of interest of all parties involved in the ecosystem.

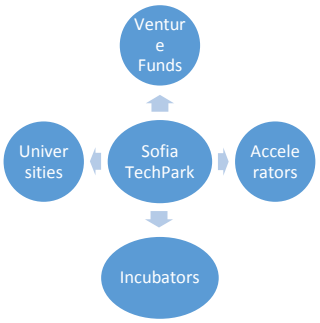

Fig. 1. Ecosystem in Bulgaria

3. Methodology and research design

Business leaders worldwide are concerned about innovative product or services entering their market. Proactive technology adoption is a key to product or service differentiation. Now and again a wide range of innovative technologies can make it harder to identify true breakthrough technologies. Many efforts at innovation and business model innovation fail. To change that, executives need to understand and predict how business models develop through predictable stages over time — and then apply that understanding to

key decisions about new business models. The role of all stakeholders at the adoption process, each with detailed domain knowledge and expertise, are critical.

Many of the efforts involve implementing new information systems and information technology (IS/IT) for integrating existing systems to supply improved services. That are vital to the success of developments. A qualitative multiple case study approach is adopted to empirically highlight the different categories of stakeholders involved in the IT/IS adoption process, the dynamic nature and importance of their role, and why their domain knowledge and expertise are vital for IS/IT projects.

Main stakeholders and their roles in the process are:

R&D is a source of new knowledge presented by academic and research institutions. R&D generate ideas in large quantities and a future investigation and development is needed to attract a future investment.

R&BD presents the Research and Business Development process of a technological innovation. Incubators and Accelerators select the most promising ideas and prototypes. A business **and financial analysis is further needed in order to support the selection process.**

Industrial sector use processes that produce materials and information and supports the development of prototypes and pilot product or service.

Business sector has storefronts that offer goods and services to customers, directly implementing the process of commercialization.

Residential sector represents communities that offer lessons learned and best practices and evaluates the value of the products and services on the market. Knowing the customers is the most important of startup success, we need to learn about their problems and needs.

There are many risks and uncertainties during this cycle which are top priority for all stakeholders. Mostly it is local ecosystem, which prove the final results – figure 2.

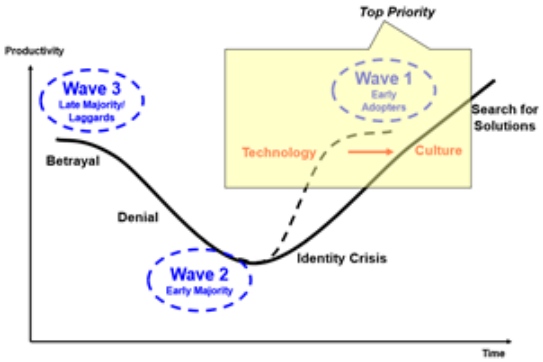

Fig. 2: Learnings from technology adoption [16]

A functional model of active/creative intermediary (broker) for the transfer of research results from publicly funded research organizations to other spheres of public activity in Bulgaria is described in PhD thesis [17]. The implemented model leads to improved innovation processes and supports the technology transfer stage through virtual broker at stage R&D and R&BD. In order to support the entire process of technology commercialization we suggest inclusion of all stakeholders in the system and inclusion of technology evaluation processes in the system.

An on-line Google study (January 14th, 2017) on the results has also shown the following results buttressing the shared view between the authors (table 1). From the implemented research it is clear that the fields of "Technology Assessment" and "Technology

Adoption" attract the highest levels of interest for all stakeholders. Reviews covered areas related to technology acquisition and utilization and evaluation processes related to the technology adoption decisions. Analysis of the information resulted in four major themes emerging as important to innovative technology adoption decision processes: management, technology, marketability and profitability.

Table 1. Summary of the search results by search term (in thousands)

	Technology assessment	Technology appraisal	Technology valuation	Technology evaluation	Technology adoption
Google search	5210	207	31,9	482	425
Google scholar	929	17	1,48	62,3	208

State of the art of technology assessment has been investigated from many authors [4, 6, 7, 8]. The results are described in a previous article of the authors [19, 20]. We have found only one generic method that systematically assesses the economic and technical aspects of technology. The model has been developed by the Korean government funded organization The Korea Technology Finance Corporation (KOTEC) [9, 15].

To develop a standardized and statistically sensible evaluation model for technology venture selection would make the most sense we believed. Bulgarian research team started exploring through literature review and an Internet key-word search in order to locate possible best practices and case studies in Europe, Asia and North America and the best we believe is a methodology successfully applied in South Korea – KTRS (KOTEC Technology Rating System).

Fortunately, the team was able to meet a professional in the knowledge sharing program of Deaduk Innovation Park. Through a series of discussions based on comparative analysis of stakeholders surrounding innovative business ventures in Korea and Bulgaria, both came to agree that it is likely that the KTRS system is suitable for the situation in Bulgaria. At least, it deserves studies from the mutual side. This is how authors got together writing this paper. Authors agreed that technology adoption and appraisal of start-ups is vital for all stakeholders, if they want to increase their chances of success. This essential validation data cannot be found in participating at different type of workshops. Entrepreneurial teams must use a proven scientific method or system to assess currently growth potential of the technology and measure risk of product development hypotheses of their potential customers.

3. Illustration of KTRS system

KOTEC Technology Rating System (KTRS) was originally developed for technology ventures without sufficient past business track record to get bank loan [10, 11]. Korea Technology Finance Corporation (KOTEC) that developed the system intended to use it for its own credit guarantee business. KOTEC's guarantee business is direct guarantee, which means KOTEC evaluates technology businesses and provide guarantee to bank loans directly; contrary to European practice of indirect guarantee where credit guarantee institutions entrust banks to cover certain loans with guarantee on their own discretion, and manage the risk with cap.

In summary, the system was to better serve technology-driven SMEs whose technologies are either invented on their own or transferred from elsewhere to sustain the early stage of venture and cross the "Valley of Death" area – figure 3 [3]. It refers to the time when the start-up runs out of funds and creates a negative cash flow before a steady stream of revenues can be established.

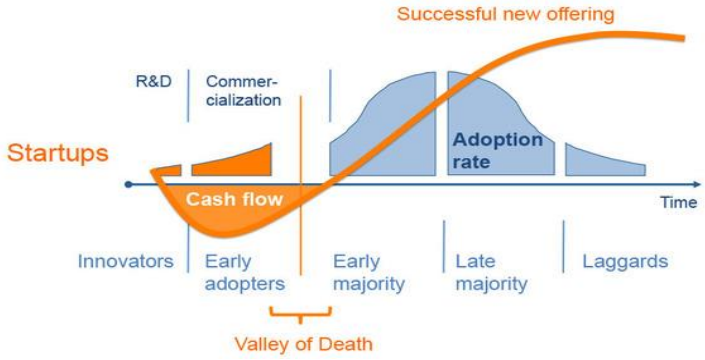

Fig. 3. Start-ups Cash flow [3]

The financing valley of death commonly tests the commitment, determination, and problem solving ability of every entrepreneurial team because it is when the start-up team produces remarkable value out of nothing. Korea Technology Finance Corporation together with Yonsei University sought to establish a system other than conventional credit rating system that sensibly select tech startups with the right potentials to do so. Also, as a big financial institution, that has branch presence nationwide with more than 1,000 staff, it needed to design a system that can remove disparity in evaluation capability among individuals allowing anyone with average intelligence and common sense would reach the same evaluation result. In addition, the system should enable risk management of the financial institution.

The team carried out generation process by sticking to the following process:

1. Different viewpoints are well gathered in the form of candidate evaluation criteria through brain storming from sufficiently large number of experts in and out of the organization from diverse cross-functional domains.
2. Final criteria to be included in the system are selected and agreed through Delphi method that mixes the virtues individual knowledge with social learning among experts in different fields.
3. Variations regarding priority are smoothened by placing weight through AHP method.
4. Guidelines for evaluation are placed detailed enough for any person with average degree of intelligence and common sense can clearly understand how to rate without falling into subjective guess or estimation.
5. Outcome that are displayed as grade or score range rather than opinion should have clear definition to express the degree of excellence pertaining to the purpose of evaluation.
6. System is enhanced and improved statistically as data accumulates through time.
7. Project leader does not set up the initial tone and remain neutral for the entire process.

KOTEC KTRS applies a scoring model to assess technology in four categories - management competence, technical feasibility, marketability and business feasibility and profitability figure 4.

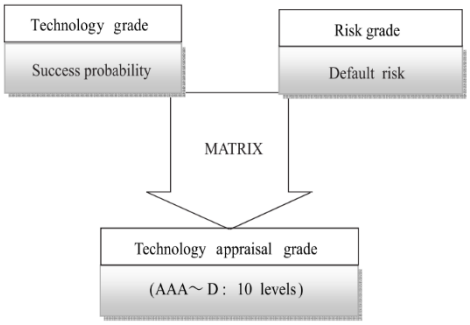

Fig. 4. System of technology appraisal model [10]

The system is unique in that the final output of the rating, the grade ranging from AAA to D, not only assesses the future success potential, but also predicts the probability of failure (default) just as credit rating does. Unlike credit rating, it uses few of the information from the financial statement, but it utilizes more of other information such as management competence, technology prospect, market attractiveness, and commercialization potential as Venture Capitals often does – figure 5.

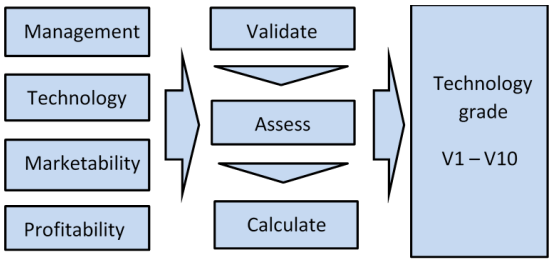

Fig. 5. Technology grading assessment

The system is also distinguished from other evaluation criteria or scoring model in that it counts in the risk of defaulting loan, which means it factors in both success potential and probability of business failure [14].

Firstly, the idea was not accepted well in and out of the organization. Management gave the benefit of the doubt. As time elapsed, the system has proved its legitimacy and Korean government entrusted KOTEC to issue venture certificate in combination with credit guarantee: In Korea, government certify certain businesses as 'Venture Enterprise' to give various benefits in systematic and standardized way.

Venture certification is bestowed to the firms, which has growth potential from new business ideas or technologies. The venture certification system was designed to prepare for the era of the knowledge-based economy by directing potential entrepreneurs' attention to such business models by providing consorted supports in accordance with 'Act on Special Measures for the Promotion of Venture Businesses (September, 1997)' [22]**.** The purpose of the certification was to create an effective diffusion of a new concept of knowledge-based business by encouraging entrepreneurs to open and carry forward such businesses. In addition, by selecting those with high prospect of delivering economic potential of technology better, government could allocate resources more sensibly.

In Sum, the system is now used not only for the benefit of KOTEC's credit guarantee business but also used for the selection of promising ventures for the nation.

4. Implication of adopting standardized rating system

When selecting start-ups for various purposes of support programs, a group of experts gather together and judge candidates by listening and asking some questions to short pitching after taking a look at written documents highlighting the merits of technology or business ideas on evaluation. Such expert committee method has a pitfall of being subjective. Although it is composed of different people, they are still exposed to *anchoring* and *group thinking*. Innovation-based business ideas are quite a puzzle that groups often go wrong by receiving incorrect signals from the members with high authority, high academic degree or simply who spoke first. The members also may be prone to reputational pressures that make them avoid disapproving others' judgment. To make matters worse, there are not really many people who understand both technology aspects and commercialization potential.

When selection or evaluation happens, the judgment is better to be made and expressed in a systematic way rather than opinions out of subjective feelings or professional viewpoints that are prone to the colors and tones of the occasion or conformity of familiar field. The standardized evaluation system helps people not to fall victim to subjectivity, not to deviate from the original purpose of evaluation, and to better communicate the outcome with the entities that are to be evaluated and other parties who may use the result as critical information.

Evaluating innovation requires significant degree of sophistication. It may still be fine or even better to rely on experts who are well-experienced and seasoned in the innovative business domain. If such seasoned professionals in both technology and business are not easily employable, the usage of standardized rating system makes more sense. Besides the degree of sophistication of rating system, we need to pay attention to the motivation of entrepreneurs to use rating system. The system in this case is for the benefit of communication with stakeholders, innovators, distribution channels and consumers.

In startup financing, the term valley of death relates to the period of time with negative cash flows, usually from the seed stage to the generation of positive net income. As companies with negative cash flows need external financing, failing to obtain it inevitably leads to failure. To bridge the valley of death, various supporters should step in. In the initial stage, these are likely to be friends and family, followed by angel investors, why at the later stages venture capitalists step forward – figure 6.

Over and over again startups with good chances fail to get access to external capital. On the other side start-ups with weaker prospects obtain financing, but fall down afterwards. This suggests that the financing decisions may well not asses the commercialization potential of technology: (i) friends and family are emotionally driven (ii) grants, foundations and state programs have flawed selection criteria (iii) angel investors and venture capitalists often delegate the analysis to the entrepreneurs, partly because they cannot evaluate the implications of the technology.

Well established rating system made out of cross-functional cohort of various stakeholders surrounding the startup ecosystem enables swift and efficient communication because definition and significance of rating outcome is already shared among the stakeholders. Thus, well created rating system would function as media for various stakeholders to crowd in for helping the right ones to be supported.

A closer look into decision making mechanism reveals that there is not sufficient information supporting the decision making process, and also that there is not available system, developed to support this process with the participation of all stakeholders. The low rate of technology adoption at the market is one of the leading factors for failure of start-ups.

A holistic model that could assess the profitability and the marketability of technology would fill in the gap and contribute to the more efficient allocation of capital. Such method,

framework and IT system would reduce the burden on entrepreneurs and provide robust decision-making foundation for angel investors and venture capitalists.

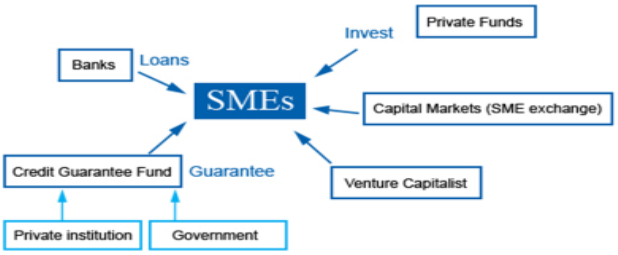

Fig. 6: Technology financing landscape

It's clear that not all technology adoption decisions and practices are successful. Start-ups and established firm performance are at great level of risk and they need a model for technology ventures selection. The other benefit of using such system is signaling and leading. Well thought evaluation criteria function as signal for startups to which elements they should have to be rated high and for those who failed to be selected can take the result as productive feedback to which way they should proceed afterward.

5. Conclusive remarks

Our findings also show that here is an extraordinary need for future development and improvement of the technology rating systems in terms of business potential. The experiences with the KTRS model in Korea can provide supportive information for the Bulgarian innovative and entrepreneurial ecosystem. It will also address how to best utilize the outcome of the rating for signaling to different stakeholders in the eco system and leading the entrepreneurs in desired direction by leveraging ICT technology. Lastly, a reliable technology business rating system will improve the allocation of capital.

Among the venture funds that invest in Bulgaria are Eleven and LaunchHub. Some of the universities that could benefit from the technology appraisal system are Sofia University, Technical University Sofia, Technical Universities of Varna, Gabrovo and Ruse and etc.

Universities could focus better its research toward technologies with good prospects of commercialization. Incubators and accelerators will pick companies at seed stage, without any track record and collateral, but having good chances of being noticed by venture funds. The technology business rating system may also find application in technology transfer, investments, credit and Mergers and Acquisitions (M&A).

The system can stimulate and support: 1) technological innovation, 2) research and development (R&D, R&BD) processes, 3) foster and encourage all stakeholders in technological innovation and entrepreneurship, and 4) increase public and private sector commercialization. It obviously deserves deeper future study.

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Information Systems for Sustainable Organizations

Juliana Peneva, Stanislav Ivanov

New Bulgarian University, Dept. of Informatics, Sofia, Bulgaria
jpeneva@nbu.bg , sivanov@nbu.bg

Abstract. Nowadays sustainability is a broad and complex concept, which should be applied to any significant economic activity. Sustainable development involves environmental, economic and social aspects of long-term local and global processes implying an overall progress. Various contradicting requests arise which organizations should resolve in their projects and the proper information support becomes a key factor for this. In the context of the above, the goal of this paper is to examine how information systems within the organization contribute for sustainable development by providing appropriate information services. The monitoring and reporting of the organisational impact on sustainability is constantly required both by members and business partners. Thus, sustainability can be viewed as a new dimension of information system assessment.

Keywords. Information systems, Organizational sustainability

1. Introduction

Recently information systems have become an important managerial tool that helps organizations to operate in a global economy. From a business perspective, an information system provides a solution to a problem or challenge facing a firm and provides real economic value to the business. Organizations are trying to become more competitive and efficient by transforming themselves into digital firms where nearly all core business processes and relationships with customers, suppliers, and employees are digitally enabled.

There are several definitions of the notion of sustainability. The UN definition states that sustainability is "doing what is required to meet the needs of the present without compromising the ability of future generations to meet their own needs." Generally speaking, this means that driving innovations are supposed to protect the environment, human and ecological health without compromise the way of life. Sustainability is based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Being engaged in sustainability assumes to create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations [1]. Sustainable development involves environmental, economic and social aspects of long-term local and global processes implying an overall progress – the Brundtland Report [2].

In the context of the above the goal of this paper is to examine how information systems within the organization contribute for a sustainable development by providing appropriate information services. We try to evaluate the degree to which companies' information systems correspond to needs determined by the objectives of sustainability. Analyzing information systems enabled organizational practices and processes that improve organizational economic performance the relationship between sustainability and information system will be investigated.

2. Research background and Literature Review

Information systems consist of a series of value-adding activities for acquiring, transforming, and distributing information to improve management decision making, enhance organizational performance and, ultimately, increase firm profitability. Businesses today use information systems to achieve:

- operational excellence;
- new products and services;
- improved decision making;
- real economic value to the business.

An information system represents a combination of management, organization, and technology elements. The management dimension of information systems involves leadership, strategy, and management behavior. The technology dimension consists of computer hardware, software, data management technology, and networking/ telecommunications technology (including the Internet). The organization dimension of information systems involves the organization's hierarchy, functional specialties, business processes, culture, and political interest groups.

Sustainability is based upon three components: economic growth, social progress and environmental protection. It consists of three different dimensions: economic, environmental, and social. The economy is a subsystem of the human society that itself is part of the environment. So the environmental dimension concerns the human behavior and its impact on the nature thus representing the most important aspect of sustainability.

Organizational sustainability concerns the ability to achieve organizational goals and increase long-term member and business partners' value by integrating economic, environmental and social opportunities into organizational strategies. Companies can integrate sustainability in their daily business operation along the following primary dimensions [3]:

- strategy -ensure realistic vision and goals for the organization;
- product/services – confirm high quality deliverables;
- human resources – make certain a reliable and efficient performance of the personnel;
- finances – conduct financial reserve and contingency planning.

The conformance of sustainability terms to internal organizational terms is shown on Fig.1 [4]:

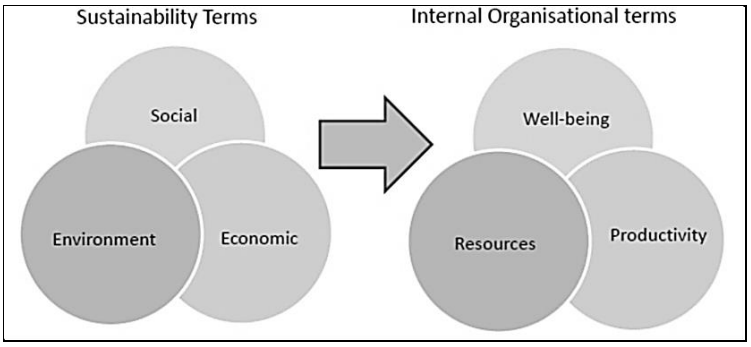

Fig.1 (Copyright David Alman 2011)

Well-being concerns employees' satisfaction and health. Resources covers energy and material uses, i.e. their sustainable consumption. Productivity reflects the value of

product/services and deals with their optimization as outcomes of the business.

Nevertheless that information system is important for the sustainable development of any business organization the relationship between sustainability and information system is subject to a limited academic research. The three sustainability aspects in relation to information systems have been investigated in [5]. Criteria of sustainable information system which could be used as a pattern for comparing information systems regarding with the concept of sustainability and a proper structure – a sustainable target cube - have been proposed [6]. The role of information systems to achieve sustainability in business processes has been evaluated by Caldelli and Parmigiani [7]. Chen [8] analyzed how information systems can help organizations develop ecological sustainability. Information systems are important in improving the economic performance and promoting sustainable processes and practices in the organization [9]. In response researchers have started to analyze the role of information systems and the way they contribute to the environmental sustainability [10]. The use of information systems to improve sustainability across the economy has been defined as "Green IS" [11]. This view comprises improving the efficiency in industries such as the transportation, manufacturing, and energy sectors that are major sources of toxic emissions. However the production and use of computers is a fast-growing component of global energy consumption because the increase in computing power leads to an increasing demand for electricity, cooling and space. So, "Green IT" describe: "… the study and practice of designing, manufacturing, using and disposing of computer, servers and associated subsystems … efficiently and effectively with minimal or no impact on the environment."[12]. Achieving environmental sustainability involves the attempts to reduce the environmental impacts of information technology production and use.

3. Green IS and Green IT: concepts and issues

Information Systems (IS) integrates Information Technology solutions and business processes to meet the information needs of businesses and other enterprises enabling them to meet their objectives in an effective and efficient way [13]. According to the business dictionary, an Information System is "a combination of hardware, software, infrastructure and trained personnel organized to facilitate planning, control, coordination and decision making in an organization." Green IS refers to the design and implementation of information systems that contribute to sustainable business processes [11]. They encompass organizational practices and processes that improve environmental and economic performance. Green IS facilitate sustainability by the provision of accurate, timely, and useful information concerning the uses of different resources and their implication on organizational costs, savings, and earnings. There are different green IS practices:

- reducing business and production processes' consumption of resources by tracking resource flows, waste, and emissions to provide information for environmental control and sustainability-oriented decision-making;
- generating innovative end products and infrastructure solutions e.g. digital services instead of physical assets, engine control units traffic management systems etc.);
- reengineering of business and production processes that enhance (natural) resource efficiency.

We stick to the view that information technologies are a component of information systems thus focusing on hardware and software resources that facilitate information activities within the organization. Green IT refers to environmentally sound IT that addresses energy consumption and waste associated with the use of hardware and software. Green IT allows for

a better utilization of computing resources and comprises activities that decrease the negative environmental impact of the overall IT infrastructure. The main concerns are:

- resource requirements of the manufacturing hardware;
- electronic waste due to legacy IT equipment;
- power consumption of all devices operated by the organization.

Therefore Green IT practices concentrate on:

- achieving energy efficient IT operations within the organization;
- taking into account environmental criteria when acquiring hardware, software, and services;
- virtualization that permits to use fewer servers, thus decreasing electricity consumption and waste heat]
- applying environmentally friendly practices referring to the disposal of IT equipment (telecommuting, remote computer administration to reduce transportation emmissions);
- using renewable energy sources to power data centers.

The difference between Green IS and Green IT consists in the way sustainability has been approached. Green IT addresses the question "How to reduce the impact of technologies on the environment" while Green IS refers to the development and use of information systems to enable environmental sustainability initiatives. The impacts of IT on the environment are ranked as follows [14]:

- 1st order: direct impacts concerning the physical existence of IT (environmental impacts of the production, use, recycling and disposal of hardware) during the product lifecycle;
- 2nd order: indirect environmental impacts of IT due to its power to change processes (such as industrial production or transportation), influencing their environmental characteristics;
- 3rd order: long-term and dynamic impacts concerning changes in lifestyles or economic structures because of the widespread use of IT e.g. telecommuting.

Green IT denotes the first-order environmental effects of information systems (manufacturing, use, and disposal of IT equipment) while Green IS covers the second-order impacts (greening of business and production processes) and third-order impacts (reduced resource consumption, waste, and emissions during the lifecycle of end products and services). Green IT is a part of Green IS. Green IT measures refer to the operational and tactical management of IT departments. The basic functional structures of any organization include finance and accounting, engineering and design, marketing, human resource and manufacturing. Each of these functional structures is a consumer of IT. Analyses are to be performed so as to control how information systems provide the much needed solution to environmental pollution problem.

Green IS practices influence organizational core processes. Green IS contributes to the development of strategic organizational systems that allow for sustainable business measures. Green IT focuses on energy efficiency and utilization of equipment in organizations. Information systems are essentially related to information technologies because IT provides the infrastructure on which ISs are implemented. So, all concepts that apply to Green IT can be discussed as part of Green IS.

The scope of Green IT and Green IS are illustrated on Fig.2 [15].

A considerable productivity improvement is a result of information systems. Currently, many organizations can achieve a sustainable development by improving productivity, reducing costs, and enhancing profitability. However due to bad environmental practices such as unused resources, energy inefficiency, and bad emissions they lose economic efficiency.

That's why the different Green IS initiatives could improve the poor environmental practices. As sustainability appears to be a challenge of modern society and information is a valuable asset so, solutions could be proposed by information systems. A design theory concerning how to build information systems that allow organizations to perform environmentally sustainable work practices and make environmentally sustainable decisions is presented in [16].

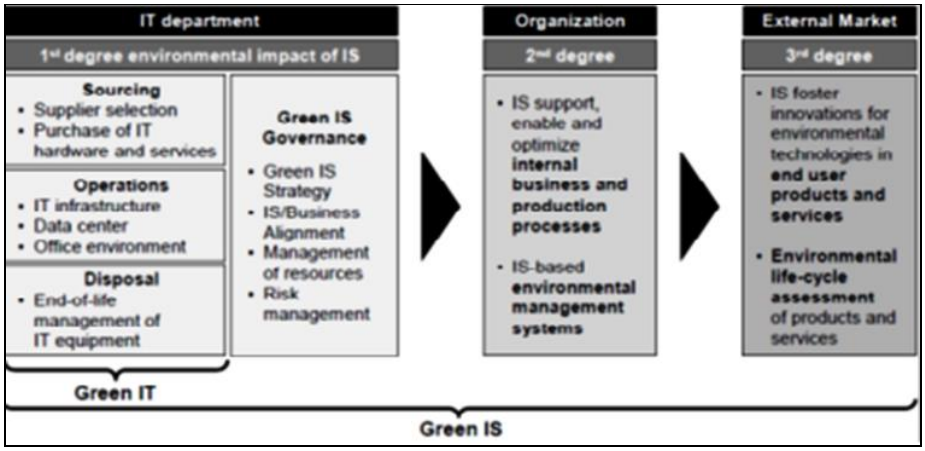

Fig.2 Scope of Green IT and Green IS

4. Conclusion

In this paper we tried to examine how information systems within the organization contribute for sustainable development. Sustainable measures can be viewed as a necessity so as organizations to remain competitive in the future. As the field of Green IS and IT is a relatively new one, we followed a literature review strategy as a main method. A review of the Green IS and IT academic and practitioner literature as well as literature on the technical, social and process views of IS has been performed. This method is suitable to analyze the difference among the proper concepts. We tried to provide clear definitions of Green IT and Green IS based on the findings in the current academic literature and to delineate the basic differences concerning their scope. Green IS represents a new and promising research area that concerns with the use of information systems to provide good environmental practices. At the same time a significant number of frameworks for Green IT have been proposed versus models for Green IS. In our opinion more efforts have to be directed to Green IS in order to provide a background for their implementation within the organization.

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CCC-Cross Country Consumption of Raw Materials Due to Their Quality – Does the Statistics Encounters It?

Bancho Banov

Faculty of Economics and Business Administration, Sofia University, Sofia, Bulgaria
banov@bcci.bg

Abstract. The paper reviews current trends in international trade and local consumption due to Globalization and Internationalization of the Economy. Furthermore, the question is, whether all this aspects are encountered by the National Statistical Institute of Bulgaria. In the article is described an observation of new phenomenon, called by the author with working title "Cross Country Consumption" In the cases of food consumption and cross export it could be called "Food arbitrage". In the case where same action, but with raw materials is involved, it could be called "Raw materials arbitrage". This Cross Country Consumption is due to the different qualities of the same on first sight products. For instance all of the grain, produced in Bulgaria has been exported for Italy and Greece. Due to the high quality of the grain it serves for production of Spaghetti, part of which return as ready product again to Bulgaria, sold at very high price. The need of Bulgaria of grain for production of bread has been covered by import of the same product – grain but with much lower quality from Ukraine and Russia. This is what author called Cross Country Consumption of Raw Materials due to different Quality. There are two more examples – with Tobacco leaves and Copper Ore.

Keywords. Cross Country Consumption, Food arbitrage, Raw materials arbitrage, International trade, Quality of raw materials and their export.

1. Introduction

In international trade and local consumption due to Globalization and Internationalization of the Economy is observed a new phenomenon:

This is called by the author with working title "Cross Country Consumption". This Cross Country Consumption is due to the different qualities of the same on first sight products.

For instance all of the grain, produced in Bulgaria has been exported for Italy and Greece. Due to the high quality of the grain it serves for production of Spaghetti (or more modern name "Pasta"), part of which return as ready (final) product again to Bulgaria, sold at very high price. The need of Bulgaria of grain for production of bread has been covered by import of the same product – grain but with much lower quality from Ukraine and Russia. This is what author called Cross Country Consumption of Raw Materials due to different Quality. There is information that Syria in 1990-s did the same thing – exported almost all domestic grain for Italy and covered its need for grain from other countries with lower quality grain. This is because – and Syria and Bulgaria produced so called "hard grain", which is very suitable for production of Spaghetti.

There are two more examples:

First is with Tobacco leaves

Bulgarian Tobacco leaves, due to their high quality, have been exported for China, where Chinese producers produce (oriental) cigars. Chinese tobacco leaves, on other hand,

with lower quality and cheaper, have been exported to Bulgaria to produce Bulgarian cigarettes.

Next example:

Bulgarian slaughtered lambs due to their high taste qualities, /which are especially bought on Easter Holiday/ have been exported to Arab countries. In reverse for Bulgaria have been imported slaughtered lambs due to their lower taste qualities from New Zealand /and offered as domestic meet/. There is information that as well that slaughtered lambs from Romania again are imported to Bulgarian market and sold as Domestic meat.

Next example:

Copper Ore from Bulgaria, due to its high quality and containment of silver and gold has been exported to Zimbabwe, where a Western company has established a Plant with very polluting technology /not possible to operate within EU/ to extract gold and silver from the Ore and further to produce Copper.

Almost same volume of Zimbabwe Copper Ore, without containment of gold and silver has been exported for Bulgaria for production of semiconductors.

Third example:

Bulgarian tomatoes have been exported to China, an there offered at high price with Label: "Made in Bulgaria". In reverse the need of tomatoes is partially covered by the domestic market, but partially covered with lower quality tomatoes export from Turkey and Macedonia.

2. Explanation

It is interesting to find out that in all above mentioned examples are subject of a kind of arbitrage. For food we could call it "Food arbitrage", for raw materials it could be called "Raw materials arbitrage". In the case of food, the same kinds of food are either exchanged, or exported from one country and imported from another. The higher quality food is exported to richer countries, which consumers are willing to and pay more. The deficit for that kind of food which occur due to export is substituted by import of the same type of food with much lower quality, and which is affordable in the original country (which is by definition poor).

In the case of Copper Ore, the entrepreneurs found out that it is much more profitable to export the Copper Ore, containing silver and gold elements, which they could not extract, and to import the same quantity Copper Ore without containing silver and gold elements, which they will use for production of semiconductors. And in that case transport costs to Zimbabwe and from Zimbabwe are encountered, and despite of them, the deal is still very profitable.

It would be interesting to see what statistics say about it. The National Statistical Yearbook of Republic of Bulgaria for 1991, says that in year 1990 (when Bulgaria has been relatively closed economy, trade was state-owned), so in that year the export of cereals (which contain grain) is only for 59,3 million leva on current prices (The National Statistical Yearbook of Republic of Bulgaria for 1991, Chapter "Export of Industrial and Agricultural Commodities, page 301, and see also page 306.). There were two exchange rates of Bulgarian Lev for 1990. First one – 100 Usd = 80,90 Leva, i.e. 1 Usd= 0,89 Leva (See Banov, B. "The Crises and Foreign Debts, Bulgarian Foreign Debt after 1990."Sofia University Press, 2016, page 118.). There is another exchange rate , called exchange rate with tax, which on 31.03.1990 was 245,11 leva for 100 USD or 2,45 leva for 1 USD (See Annual Report of Bulgarian National Bank for Year 1990, page 84.). Even if we take not so advantageous rate of 1 Usd= 0,89 Leva, that means that in 1990 Bulgaria exported 59,3Million Leva: 0,89= 66,62 million dollars cereals. For the import in 1990 the grain import is not specified there is a chapter in The National Statistical Yearbook of Republic of Bulgaria, called: crop, which import for 1990 is

90,1 Million leva or 101,24 million Dollars (See National Statistical Yearbook of Republic of Bulgaria for 1991, page 304.).

The National Statistical Yearbook of Republic of Bulgaria for Year 1993 is more detailed. There is a Chapter „Corn", the import for year 1992 is 740,4 Million Tons (for 1826,2 Million Leva) and export is 21,2 million Tons (for 195,4 Million Leva). So as we could see the export of corn and in it contained grain for 1992 is quite insignificant.

Here is Statistics for mentioned in the article products for Year 2014.

Table 1.Export and import from and to Bulgaria of some items in 2012 and 2013. (National Statistical Yearbook of Republic of Bulgaria for 2014, page 245.), Million Leva

No.	Item	Export for 2012	Import for 2012	Export for 2013	Import for 2013
1.	Cereals and Grain Mill Products	2017,5	313,4	2798,7	324,3
2.	Vegetables and Fruits	443,7	589,6	481,7	642,5
3.	Tobacco and Tobacco Products	681,1	350,4	748,4	393,7
4.	Meat and Meat Products	374,3	836,8	325,6	699,9
5.	Metal Ores	1860,7	3467,8	1573,6	3765,4

If we assume that the article of the Table: "Cereals and Grain Mill Products" is only consisted with grain, we could make the following inquiry: The inquiry about prices of grain in 2013 is 300 Leva per 1 ton. We divide 324 000 000 : 300 = 1 080 000 Tons of Grain. (http://www.555.bg/agro-production/foodproducts&drinks/corn)

The conclusion is that in 2013 Bulgaria has imported 1, 08 Million Tons of Grain, which compared with import of Chapter "Corn" for 1992, consisting only 21,2 Tons is tremendous.

The export for 2013: We divide 2 798 700 000 : 300 = 9 329 000 Tons of Grain. Which is also tremendous. If we divide it to population of Bulgaria for 2013 which is 7,265 million of people, than Bulgaria exports 1,33 Tons of grain per citizen.

3. Conclusions and questions

A. Does the National statistical Institute encounters this Cross Country Consumption?
B. Does the National statistical Institute encounters not only quantities exported and imported of the raw materials but also their quality?

Conclusions:

1. This phenomena is observed in Bulgaria due to the low purchase power of the population and the higher demand in other richer countries for higher quality products, covered with higher purchasing power.
2. This phenomena is observed in Bulgaria due to the low purchase power of the population and the higher demand in other richer countries for higher quality products, covered with higher purchasing power.
3. In all these cases we are witnessing of a new International Trade Arbitrage…

4. But it is a zero sum game – while someone is winning from this arbitrage, the population of Bulgaria is losing – it is not able to consume high quality products which their own land produces…

Recommendations:

1. In the times of socialism there were for divisions of redy products, based on their quality:
    1). Extra quality
    2). First quality
    3). Second quality
    4). Third quality
2. At least National statistical Institute could start to encounter the quality of all examples of Cross Country Export. Not that we will cosume better products, but at least we will know it.

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4. National Statistical Yearbook of Republic of Bulgaria for 2014, page 245
5. http://www.555.bg/agro-production/foodproducts&drinks/corn

An Approach for Development of Programming System for Modelling and Researching the Parameters of Commercial Contracts

Silyan Arsov[1], Elitsa Ibryamova[1], Denislav Arsov[2]

[1] University of Ruse, Ruse, Bulgaria
sarsov@ecs.uni-ruse.bg , eibryamova@ecs.uni-ruse.bg

[2] California, USA
denis_arsov@yahoo.com

Abstract. In the paper, the authors present an approach for the development of programming system for modelling and researching the parameters of commercial contracts in order to assist managers in the decision making process and also to train specialists in the same field. The methods for modelling and researching the parameters of commercial contracts are introduced in the paper. Likewise, data structures that store the parameters of commercial contracts are given as tables on magnetic storage discs. Furthermore, architecture of programming system is developed on the basis of proposed methods.

Keywords. Commercial contracts, modelling and investigating parameters of commercial contracts, database, web-based system.

1. Introduction

Deliveries of goods are part of the logistics processes at enterprises, and taking in consideration the intense competitions among manufactures and retailers of goods in market conditions, the choice of suppliers is important because of the opportunities to optimize the cost of delivery.

Supplies of a product are carried out through an agreement (contract). However, before negotiation of terms start, other operations such as research of pricing conditions and others are usually undertaken.

After a supplier has been selected, negotiations of various terms of the deal start. Once the terms of the deal are agreed upon, the contractual relationships are determined. In the described procedure, trade negotiations play an important role because through them effective results can be achieved and optimal conditions for the participants in the negotiation process would be established.

The research of the commercial contracts' parameters is an important step before making a decision. The research can be carried out most effectively by using software programs. This determines the relevance of the topic to develop a software system for modelling and researching commercial contract parameters.

In addition, an effective negotiation process is a factor for long-term relations between economic entities. This determines the significance of the topic of trade negotiation in contracting delivery of goods.

For each deal, the credit can be provided by the supplier itself (commercial loan) or by a third party (a bank or other financial institution). The terms of the loan should be considered when choosing the contract, because the advantages of a given option in terms of lower cost

price can be eliminated by unprofitable buyer credit conditions (interest rate, duration of preferential period, method of loan repayment, etc.).

Four methods for repaying buyers' debt and determining the terms and conditions of commercial contracts are considered in connection with the development of Web-based system for the calculation of commercial contracts parameters.

2. Definition of methods for repaying buyers' debt and calculating the terms and conditions of commercial contracts [3], [4]

2.1. Contract with a single supply of goods

2.1.1. The general principle for determining the updated value of the payment is described by the formula:

$$V = \sum A_t M_i^t + (P - \sum A_t) C_j, \quad (1)$$

The indications at the formula (1) have the following meanings: V - updated value of buyer's expenses; C_j - reducing coefficient of buyer's expenses; A_t - amount of an advance payment in the period t; P - price (total value) of a supply; M_i^t - discounting multiplier on rate i for the period t.

i. Loan repayment by single transaction at the end of period

Calculating the costs' reducing coefficient (C_j) and the amount of the loan (S).

Costs' reducing coefficient:

$$C_j = (1+g)^N . M_i^{T+N}, \quad (2)$$

where: g – an interest on the loan, provided in the contract; N – a term of the loan, including the preferential period; T – time of delivery.

Amount of loan:

$$S = (P + \sum A_t)(1+g)^N . \quad (3)$$

2.1.3. Loan repayment by equal installments (excluding preferential period)

a) Calculating the costs' reducing coefficient (C_2) and total annual costs (y_2) in case when repayment of the obligation is done through annual payments.

Costs' reducing coefficient:

$$C_2 = \frac{a_{N;i}}{a_{N;g}} M_i^t, \quad (4) \qquad a_{N;g} = \frac{1-(1+g)^{-N}}{g}, \quad (5)$$

$$a_{N;i} = \frac{1-(1+g)^{-N}}{i}, \quad (6) \qquad M_i^t = (1+i)^{-t}, \quad (7)$$

where: $a_{N;i}$ – credit reducing coefficient for the period - N and a basic interest rate – i; $a_{N;g}$ – credit reducing coefficient for the period -N and an interest rate on the loan - g; M_i^t - discounting multiplier on rate i for the term t; N – period of setting up a repayment fund; i – basic interest rate (percent); g – loan interest.

Annual amount of expenses (y_2)

$$y_2 = \frac{P - \sum A_t}{a_{N;g}}, \quad (8)$$

where: y_2 – periodic payment (annual amount of debt service).

b) Calculating the costs' reducing coefficient (C_3) and total annual costs (y_3) in cases when repayment of the main debt and the interest thereon are made r times a year.

The costs reducing coefficient (C_3):

$$C_3 = \frac{r.a_{N;i}^{(r)}}{a_{Nr;q/r}} * M_i^T \ . \quad (9)$$

The annual amount of expenses (y_3),

$$y_3 = \frac{P - \sum A_t}{a_{Nr;q/r}} r \ . \quad (10)$$

2.1.4. Loan repayment by equal installments (including preferential period)

a) Calculating the costs' reducing coefficient (C_4) and total annual costs (y_4) in cases when repayment of the main debt and the interest are made by annual payments.

Costs' reducing coefficient (C_4):

$$C_4 = ga_{L;i} + \frac{a_{N-L;i} * M_i^{T+L}}{a_{N-L;g}}, \quad (11)$$

Annual amount of expenses:

$$y_4 = \frac{P - \sum A_t}{a_N - L_{i;g}} \ , \quad (12)$$

where: L - length of the preferential period (years).

b) Calculating the costs' reducing coefficient (C_5) and total annual costs (y_5) in cases when repayment of the main debt and the interest thereon are made r times a year.

Costs' reducing coefficient (C_5):

$$C_5 = ga_{L;i}^{(r)} + \frac{ra_{N-L;i}^{(r)}}{a_{t;g/r}} * M_i^{T+L}. \quad (13)$$

Annual amount of expenses:

$$y_5 = \frac{P - \sum A_t}{a_{t;g/r}} * r \ , \quad (14)$$

where: $t = (N - L)r$ - Total number of the payments.

2.2. Commercial contracts with deliveries throughout the term

In practice deliveries often are made for certain periods of time. If the debt is set at the end of the delivery period, so that the intermediate amounts for the supply (as well as advance payments) do not bear interest, then the current value of the costs is calculated by the formula (1).

Credit reducing coefficients are determined by formulas (2) (4) (6) in which the discounting factor M_i^T is used $\mathbf{M_i^{T+D}}$. If the loan is repaid in equal term payments (debt + interest) with a preferential period, the formulas (8) and (10) are applied in which multiplier $\mathbf{M_i^{L+T}}$ is used instead of multiplier $\mathbf{M_i^{T+D+L}}$. In these formulas, the quantity D means a period of delivery.

3. Programming system scheme for modelling and researching of commercial contracts

The scheme of the programming system for modelling commercial contracts is presented in a Fig. 1. as an object - a black box.

Controllable factors are those values which the experimenter can modify and keep at a given level during each attempt based on the experimenters' discretion [1, 2, 5]. Controllable factors are the following in commercial contracts: *P, At, T, N, g%, i%, r, L, D, h.*

Parameters: The object's parameters are the values which describe the reactions of the object caused by external impacts. In commercial contracts, parameters are ***V, S, y*** and ***F***.

The parameter values are formed as a result of controllable factors as well as disturbing (unmanageable) factors.

Controllable unmanageable factors are: z_1, z_2, .., z_n. They can be measured and practically remain constant within each experiment. This type of factors in the commercial contracts are shipping costs, delivery times of goods, legal terms and conditions, etc.

Uncontrollable unmanageable factors are: w1, w2, ..., wm. They are immeasurable or difficult to estimate. The common between them is that they are inconsistent during the different experiments.

Because of the above-referenced features of unmanageable factors, the influence of controllable and uncontrollable external impacts (factors) on the parameters is not taken into account in this implementation.

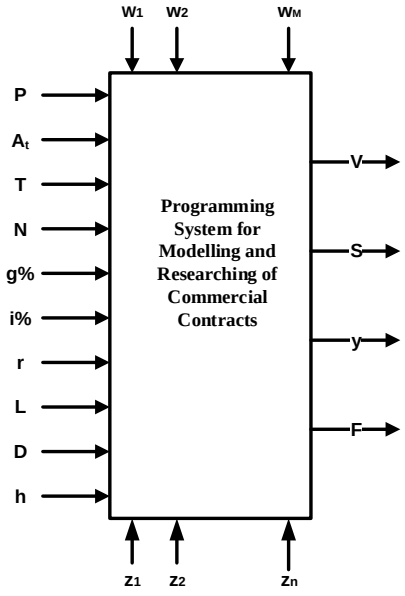

Fig.1. Programming system scheme

4. Designing data structures for storing parameters used in the various methods of buyers' debt repayment at the execution of commercial contracts [7]

The designed data structure for storing parameters is presented in the Tables 1, 2, 3.

Table 1. Input controllable factors in the commercial contracts

Column Name	Data Type	Length	Description
P	decimal	10,2	Price (total value) of a supply
A_{t1}	decimal	10,2	Amount of advanced repayment at the first period t_1
t_1	int	4	First period
A_{t2}	decimal	10,2	Amount of advanced repayment at the second period t_2
t_2	int	4	Second period
A_{tn}	decimal	10,2	Amount of advanced repayment at the period n (t_n)
t_n	int	4	Period n
N	int	4	Term of the loan, including the preferential period
T	int	4	Time of delivery
g	decimal	10,2	An interest on the loan, provided in the contract
i	decimal	10,2	Basic interest rate (percent)
r	int	2	Numbers of repayments of the main debt and interest rate for a year
L	int	4	Length of the preferential period
D	int	4	Period of deliveries related to contracts with deliveries throughout the term
h	int	5	Number of deliveries for a year related to contracts with deliveries throughout the term

Table 2. Output controllable factors in the commercial contracts

Column Name	Data Type	Length	Description
V	decimal	10,2	Updated value of buyer's expenses
S	decimal	10,2	Amount of loan
y_2	decimal	10,2	Periodic payment (annual amount of debt service) in case when repayment of the obligation is done through annual payments
y_3	decimal	10,2	Periodic payment (annual amount of debt service) in case when repayment of the

			main debt and the interest thereon are made *r* times a year
y_4	decimal	10,2	Annual amount of expenses in cases when repayment of the main debt and the interest are made by annual payments
y_5	decimal	10,2	Annual amount of expenses in cases when repayment of the main debt and the interest thereon are made *r* times a year
F	decimal	10,2	Amount of the loan repayment

Table 3. Intermediate controllable factors in the commercial contracts

Column Name	Data Type	Length	Description
C_j	decimal	10,8	Costs' reducing coefficient
$a_{N;i}$	decimal	10,8	Credit reducing coefficient for the period - N and a basic interest rate – i
$a_{N;g}$	decimal	10,8	Credit reducing coefficient for the period - N and an interest rate on the loan - g ;
M_i^T	decimal	10,8	Discounting multiplier on rate i for the period t.

5. Programming system architecture for modelling and researching parameters of commercial contracts

The programming system for modelling and researching parameters of commercial contracts consists of five functional subsystems:

- Subsystem for inserting and updating that supports the functions adding and editing of basic parameters of commercial contracts in the database.
- Subsystem for the fundamental data analysis that visualizes output data to screen and printer.
- Subsystem for selecting the method of repayment of commercial credit that includes: choosing a main method to perform the necessary calculations and recording results in the database tables.
- Subsystem for the calculated data analysis that displays the results from the implementation of chosen method for calculating the commercial contract in the form of tables on the screen and printer.
- Subsystem for graphical representation of the gotten results.

The input data can be also changed due to the proposed system to monitor variations in output parameters. Therefore a decision for the optimum commercial contract could be taken before its execution. The architecture of the software is presented in Fig. 2

The web - programming language PHP has been used for implementation of software system for modelling and researching parameters of commercial contracts while MySQL database management system has been utilized for the execution of operations for manipulating data.

Structure of data tables, that introduces the change in output parameters according to the input controllable factors, is presented on table 4, table 5 and table 6.

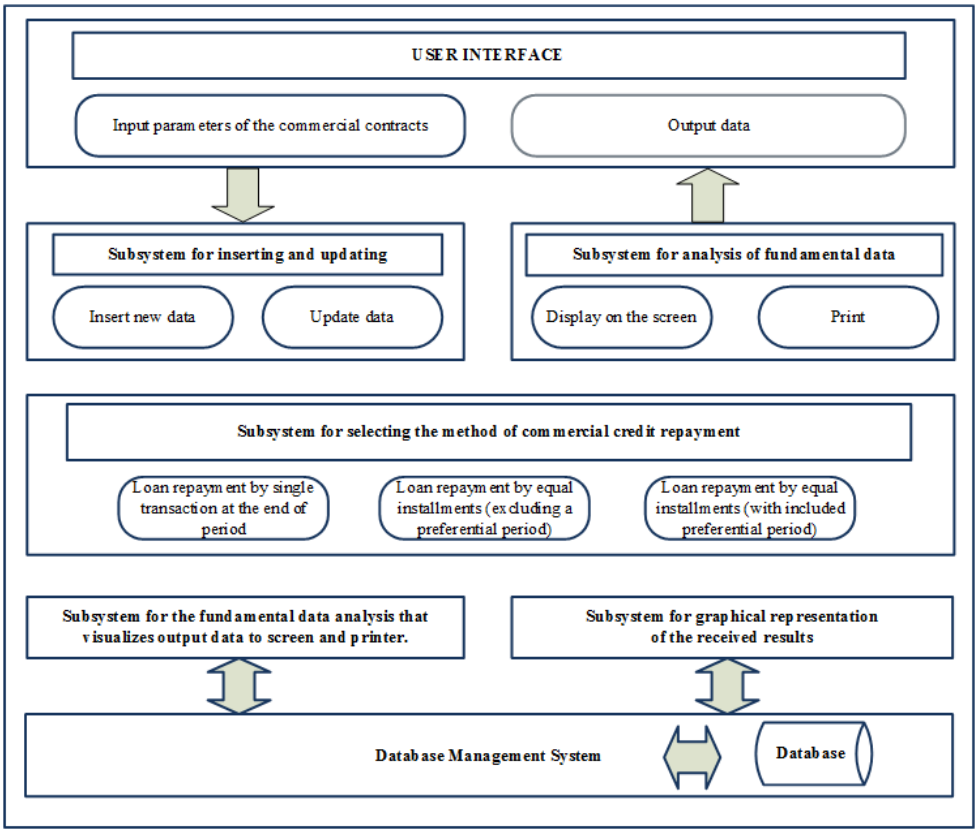

Fig. 2. Architecture of software system for modelling of commercial contracts

Table 4. Loan repayment by equal installments (excluding a preferential period)

Variant №	*P*	A_t	*T*	*N*	*g%*	*i%*	y_2	*V*
1	p_1	a_1	t_1	N_1	g_1	i_1	y_{21}	v_1
..	..	..	..	..	..	..	..	..
n	p_n	a_n	t_n	N_n	g_n	i_n	y_{2n}	v_n

Table 5. Loan repayment by equal installments (with included preferential period)

Variant №	*P*	A_t	*T*	*N*	*L*	*g%*	*i%*	y_4	*V*
1	p_1	a_1	t_1	N_1	l_1	g_1	i_1	y_{41}	v_1
..	..	..	..	..		..	..	..	..
n	p_n	a_n	t_n	N_n	l_n	g_n	i_n	y_{4n}	v_n

Table 6. Structure of the repayment plan in case of repayment of the commercial loan by equal installments (with or without preferential period)

Year	Loan balance at the beginning of the year (S)	Annual installments (y)	Interest (g)	Amount of Repayment (y-g)
1	s_1	y_1	g_1	$y_1 - g_1$
..	..	..	..	
n	s_n	y_n	g_n	$y_n - g_n$
$\sum$		$\sum(y_1 \ldots y_n)$	$\sum(g_1 .. g_n)$	$\sum(y_1 - g_1) .. (y_n - g_n)$

6. Conclusion

By using the programming system for modelling of commercial contracts, it is possible to submit different sets of controllable factors at the beginning of program start, and get different results, such as different output parameters at the end of program execution. All results are displayed in tables and graphs.

The conclusion, which of the commercial contract options is more beneficial to the buyer, is based on comparing the updated value of the buyer's expenses ***V*** (Table 4 and Table 5). The option with the lowest updated value of expenses is considered as preferred assuming all other conditions are acceptable. The creditor (seller) preference is based on indicators of the profitability of financial and credit operations (Table. 6)

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Possibilities for Improving Public Sector Services Using the Advantages of the Internet of Things

Natalia Marinova

D. A. Tsenov Academy of Economics, Svishtov, Bulgaria
n.marinova@uni-svishtov.bg

Abstract. The goal of the presented paper is to discuss shortly current strategies for Internet of Things (IoT) technology adoption and to underline its possibilities for improving the services of the public sector of the economy. The global connection between people, processes, data, and physical things into one united information computer network, which we witness during the last years, possesses a potential of creation of new advantages for the public sector, due to the capabilities of IoT for extracting and analyzing huge quantity of constantly increasing data volumes targeting the management of automate or semi-automated processes. IoT could contribute for achievement of a number of socially useful goals, including increase of the economic growth, improving the sustainability of the cities' environment and security, the quality of administrative services and the productivity of the public staff.

Keywords. Internet of Things, IoT Benefits for Public Sector, Smart City Initiatives.

1. Introduction

We are witnessing the next evolution of the contemporary information technologies, which make possible to connect physical objects to the Global network and other networks – so called Internet of things or IoT. Nevertheless, it is still in an early stage of development, the IoT technology already has predefined the way of which the electronic business is realized, the public infrastructure is managed and the people's life is organized. More and more machines, containers with goods, infrastructure elements, vehicles and people daily "equip" themselves with a network of sensors aiming collection of status quo information, receiving instructions and performing certain actions.

Even during 2012 the number of devices, connected to Internet, exceeded the numbers of the whole human population – over 9 billion linked devices in the whole world, including smartphones and computers. Most of the forecasts [11] of some research companies in the field show reaching of levels of 20.8 up to 30.7 billion linked objects in 2020. The overall changes, which this technology will lead to, cannot be evaluated yet.

2. IoT strategies in the public sector

IoT strategies in the public sector area normally refer to one of the following categories:

1. *National strategies* – in South Korea, for instance, two ministries are engaged in encouraging and implementation in various IoT initiatives – development of strategies in the field of IoT applications' security [13], R&D activities, projects about usage of RFID technology, creating of USN networks and interfaces for M2M interconnection realization.

2. *Economic and industrial development strategies* – for instance, such as the initiatives Internet of Things and Smart Cities in Great Britain, aiming coordination of the

recent services in public sector, including the work with the scientific community and creating of a favorable environment for innovations and investments in the private sector [12].

3. *Programs for transformation of a specific industrial sector* – they work most often through public-private partnership, which realize initiatives of specific solutions fast implementation [7].

4. *Sponsorship of demonstration projects* - investments in such projects are aiming to prove to the public authorities and the industry the benefits of performing and implementation of IoT projects. Programs for creating so called smart cities are already realized in Nice, Barcelona, Glasgow, etc. [4].

5. *Programs for knowledge creation through financing of R&D activities* – IoT is a main domain in 7th European Framework Program, and IoT initiatives, for instance are financed, such as (IOTi), and IoT European Research Cluster (IERC), which aim to assure "a lightweight portfolio management for overcoming isolated, redundant research and knowledge barriers" [5, 6].

6. *Governmental financing and organizing contests to stimulate innovations in the field of IoT* – such are for instance those organized by Internet of Things Special Interest Group, a part of the British Technology Strategy Board (TSB), which connects the existing networks and communities and a providing a platform for cooperation, research and development of modern innovations [8].

General **benefits**, which could be realized by the public sector applying IoT technology, are as follows [3]:

1. Increasing the productivity of the working in the sector persons on the basis of improving or creating of new public services.

2. Better opportunities for protection when emerging critical situations, disasters and accidents, due to the network connection of command centers, vehicles and deliveries.

3. Reduction of operating expenses due to the intelligent use of energy and other physical resources.

4. Overall improvement of citizen's life, achieved by reduction of downtime staying in lines before the administrative offices or public transport stations, changes of climate indicators and healthier life conditions in cities.

5. Increasing of public incomes through intelligent pricing when using public goods and services and monetization of the community material assets (parking spaces, roads).

The basic **factors**, which influence the achievement of maximum effect from using IoT applications in public sector, can be summarized as follows bellow:

- Availability of investment means in the public IoT initiatives.
- Knowing the capabilities of IoT technology as a tool for realizing of additional local incomes.
- Positive attitude of citizens – they forecast, that in cities with a higher percentage of well-educated residents the demand of IoT functionality probably will be higher than the benefits which such applications can provide.
- Achievement of higher level of operative compatibility between the heterogeneous IoT applications.
- Availability of technical capacity and support from local administrative authorities.
- Knowing the risks, related to security of the IoT based applications.

3. IoT possibilities for improvement public sector services

In order to estimate the potential effect of IoT technology in the various sectors of economy we need to outline the ways, the areas of application and the sources, which create added value up and down the value chain. Applying only the traditional approach for

measuring of future benefits (for instance by using indicators of the level of spending cuts or improvement of quality in specific branches or sectors of economy) is not sufficient. IoT applications should be viewed within the context of a concrete area of economy (for example, transport and logistics, healthcare, smart environment, personal and social domain, etc., [1]) where this technology could be applied aiming creation of added values in business organizations, customers and staff. Such a focus additionally helps to calculate the maximum value, which could be generated by joint use of various IoT applications and with the interactions between them and the other information systems and databases as a whole.

Generally speaking, the potential capabilities of IoT could be estimated as very high by the different research companies. According to Gartner for example, up to year 2020 75% of medium size and large business organizations will implement 3 or more IoT solutions, and this will lead to reduction of prices of operative information systems [9]. Cisco estimates [3], that the future value, which can be generated from the organizations in public sector as an outcome of IoT applications implementation will reach the sum of $4.6 trillion until 2022. That will lead to emerging of whole bunch of new industries, to generating of various social and economic benefits and will stimulate economic development and increase number of jobs [2].

An interesting evaluation of the eventual economic effect from using IoT applications to year 2025 is done by McKinsey Global Institute (MGI) in June, 2015. After a performed research and analysis of 150 working IoT systems worldwide, the authors of the research predict, that the expected potential value, generated from IoT applications in nine main economic areas (see fig.1) will vary from $3.9 trillion to $11.1 trillion per year. The biggest benefits (approximately 1/3) will realize the factories (plants, hospitals and farms – around $3.7 trillions), followed by cities (up to $1.7 trillion per year).

The data in the survey are extrapolated based on values of current and indicative use of IoT applications and the number of such implementations, the growth of IoT-related industries and the anticipated demographic changes. For any assessment of the potential economic impact is offered a range of possible outcomes that depend on factors such as the degree of penetration and growth rates in the sector. There have been identified also the required conditions for maximum economic advantage and barriers to implementation in each of the nine areas as well. The study estimates the benefits of existing, emerging and futuristic IoT applications that will most likely to be widely deployed in 2025. They were measured as direct financial impact (potential savings from improved utilization of equipment) and as non-financial indicators such as time saved to consumers or improved health conditions.

The cities always have been a place of innovations when applying IoT. By creating so called smart cities initiatives and entrepreneurship, they are experimenting with IoT applications aiming improvement of administrative services, relieve of traffic congestions, limiting water and electricity spending and improvement life quality as a whole.

The large concentration of population (60% of the world population) and the complicated infrastructure make the cities an appropriate environment for IoT applications. Within the cities can be realized the biggest economic effect in several main directions – healthcare and public security (including monitoring quality of air and water), transport (traffic control systems, controllers for smart parking and control the movement of autonomous vehicles) and resources and infrastructure management through controllers and sensors for better management of water supply and electricity supply infrastructure.

An estimation of the potential effect from IoT application in cities on the main directions could be done on the basis of various direct and indirect measurable indicators as it is shown in the Table 1:

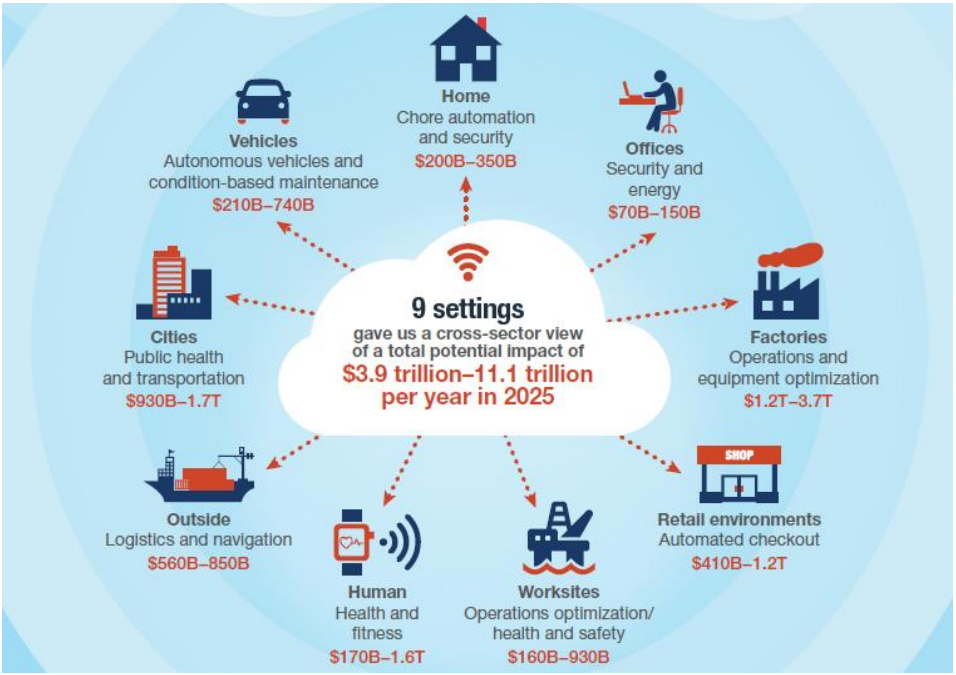

Fig 1. Expected potential benefits, generated by IoT applications in nine areas of the world economy [10].

Table 1. Potential effects of usage of IoT applications in cities

Direction	Indicator for measurement	Expected benefits	IoT applications
Monitoring of air and water	Number of death cases caused by illnesses, related to the overpopulation of the cities	Reduction of number of death cases caused by illnesses, related to the overpopulation of the cities	Sensor networks for monitoring quality of air and water
Adaptive traffic control	Time to move throughout the city and looking for a parking space	Accelerating urban travel and reduction of traffic congestions when there is a need for parking	A centralized system for traffic control, adjusting the traffic lights using the data from their embedded sensors; smart parking-meters

Autonomous vehicles	Number of death cases caused by crashes; volume of consumption of fuel; time to look for parking space;	Reducing traffic accidents; reducing fuel consumption and harmful emissions	Autonomous and semi-autonomous cargo and public transport vehicles
Management of resources and infrastructure	Costs for water, electricity, street lighting and maintaining the structural integrity of buildings	Reduction of interruptions in energy supply, water leaks and theft of resources	Sensor networks with smart metering automation distribution and allocation of resources and substations of suppliers
Disaster/emergency services	Number of death cases caused by disasters and accidents	Improvement of emergency services and disaster response	U-IT-based smart service systems and applications, that provides disaster, weather, and traffic-related information to the public
Public transit schedule management	Downtime at the stations of public transport	Reducing waiting times by using real-time information on the movement of buses and trains	Sensor networks; GPS-monitoring systems; applications for tracking the movement of vehicles
Staff productivity working in public sector	Productivity of mobile staff – operators of motor vehicles, cleaning workers, officers of the Unit Vermin, sales representatives	Increasing the productivity of mobile and knowledge workers through new working methods and monitoring activities	Mobile devices capable of using IoT technology
Crime detection and monitoring	Costs of monitoring and crime prevention	Reduction of criminal acts	Video cameras and sensors to detect gunfire and left unattended baggage
Smart solid waste pickup	Costs of garbage collection	Improving the productivity of garbage disposal companies	IoT-based smart garbage system composed of a number of smart garbage bins, routers, and servers

4. Conclusion

Transformational impact of IoT in public sector will be implemented through complete change of the way of creating public services and the possibilities of using the extracted information in order to more effectively meet the needs of citizens. Realizing of maximum future benefits of IoT applications in cities will depend on such factors as availability of operative compatibility between the various IoT systems, better use of IoT collected data for analysis and decision making, the availability of technical capacity and support from the local authorities, etc. Nevertheless, for several years we have seen a number of successful initiatives by creating smart cities in global meaning, direct and indirect measurable benefits to citizens and businesses, indicating that investments in such projects are justified.

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A Model of Hotel Revenue Management System for Training Purposes

Svetlana Vasileva

Varna University of Management, Varna, Bulgaria
svetlanaeli@abv.bg

Abstract. The aim of the work is to review some opportunities of GPSS World for the creation and applying simulation models in the training of students in Hotel management. The proposed model of Hotel Revenue Management System is presented in details: The module for booking and the calculation of the variables describing the hotel revenue (Occupancy rate, Average daily rate, etc.). The modeling algorithm is developed by means of Simulation modeling environment for GPSS World, and as a means of implementation are used the new upgrading GPSS editors: Extended Editor and Universal Editor of Forms.

Keywords. Hotel revenue management, GPSS World, Modeling algorithm.

1. Introduction

Social sciences in Bulgaria are underdeveloped in terms of experimental science. The project presented here aims at introducing simulation in management and education for the purpose of development of a sustainable tourism industry as well as a separate economic sector and in terms of governance. (In the designed simulation model inflows of GPSS transactions can model various types of tourist flows (nations, interests and other characteristics of tourist flows) that simulation will be examined, in order to take certain decisions concerning the management of the examined events and organizations of importance to the objectives of the training or research).

One of the current tasks in Informatics is the problem of creating a methodology to the study of real objects by means of computer technology and science. I.e. it is a problem of creation of information models upon which to determine the theoretical significance and practical value of any system in the conditions of the impacts of the external environment [1]. This is extremely important in the initial stage of development of every innovation and also in the training of specialists in the field of management, such as students in Business Administration, Marketing and management, Hospitality Management, Marketing and Management of the tourist services, and others learning in Varna University of Management.

Imitation modeling methods allow researchers to create models of complex systems. And it still remains a scientific field. [1] Our purpose is to implement simulation models in training, but as a destination also to business – to actually use autonomous applications as support systems decision-making in the tourism industry.

In order to develop an industry (in this case - Hospitality) and to be effective it is necessary to prepare the relevant professionals - managers. One of the main skills the teachers need to develop and all future managers of first place in the economy in all its branches (also during training), is systemic thinking. Characterized by: context-conditioned, unemotional, and operable. [2] Simulation provides an extremely powerful tool for the development of such skills, especially since had emerged so called automation systems for imitation research. These

are the Advanced Editor [3] and Universal Forms Editor [4] developed on the system GPSS World [5]. These extensions enable specialists in specific subject area (as the case of Business Management, Tourism Management) to be an active part of the team that developed the simulation applications. This would stimulate the development of training simulation applications and the applications would be much more effective, because the logic of experts / teachers bet directly into products under development.

Currently, worldwide, there are simulation applications developed by specialized companies, but except that they are expensive (even for academic purposes), this kind of software does not have the flexibility and "individual orientation" as the discussed simulation applications.

2. The Idea of the Modeling Algorithm

The concept of (parametric) simulation models of hotel revenue management systems is first to be used to train managers in the hotel business and next to be implemented in the hotel business and management. Simulation of Hotel Revenue Management System [6] includes according to [7] the following tasks:

- Defining and classifying numerical indicators involved in measuring the condition of a hotel. It takes account of: habitat, in which the hotel business will develop; tourist flows, users of the services offered in the area; external environment of the hotel, subject of interest from various tourist flows;
- Drawing up of conceptual model of a hotel revenue management system (RMS) for the purpose of simulations by means of the GPSS World environment and determination of input parameters and expressions involving;
- Modeling modules forming the revenue of hotel;
- Drawing up algorithms and modeling work management system revenues hotel. Setting the models, validation and verification;
- Implementation and approbation of simulation models will be made by means of Extended Editor and Universal form editor of GPSS World. The Universal form editor provides extremely useful for the purposes of simulation research project means: Data input Form; Form for planning of the experiment (single and multiple experiments); Form for monitoring the dynamics of the experiment; Animation form for presenting work model;
- Formulating conclusions for future extensions and applications of the methodology of parametric GPSS World models in the creative and recreational industries.

3. GPSS Model of the Hotel Booking System

Simulation modeling allows to study the queuing systems for different types of input flows and intensities of arrival of requests at the entrances of systems, and to determine the main features of the same. One of the systems used for simulation modeling - GPSS World [5] provides users with the means to interact with the system in the process of simulation research and software, realizing immediate the process of implementing of the model. As objects of GPSS language used analogues of standard components of the queuing systems, such as queries, serving devices, queues, etc. The sufficient set of these components enables the design of complex simulation models, while retaining the familiar terminology of queuing systems.

Simulation algorithm comprises the following steps [7]:

1. Generating flow of transactions;
2. To the generated GPSS transaction are given the values of the parameters (fig. 1);

3. Looking for free room in the "Booking" matrices (*MX$RoomList* and *MX$Booking*). Fig. 2 shows searching in the first rooms' segment of the modeled hotel;
4. Booking – booking a room for dates, that were given by the parameters P1, P2, P4 and P5 - if a free room is found;
5. GPSS transaction leaves the model.

```
PotokBook     GENERATE    60,FN$XPDIS
              ASSIGN      1,FN$MonthSumme                    ;month of the generated transaction.
                                          ; The value is determined by the function FN$MonthSummer
              QUEUE       TotalB
              QUEUE       Rezervacii
              GATE FV     SiteBook
              SEIZE       SiteBook
              FUNAVAIL    SiteBook
              DEPART      Rezervacii
              ASSIGN      2,V$DayBook1                       ;Day of the month P1 - - random value
; in the interval [1, <last day of the month set in P1>] - The first date of requested overnights
              ASSIGN      3,7                                ;Length of the booking request
              ASSIGN      4,P1                               ;The month of the last requested overnight date
              ASSIGN      5,V$DayBook2                       ;Day of the month of the last requested overnight date
              TEST G      P5,V$DayMonths,ProverRoom
              ASSIGN      4+,1
              ASSIGN      5,V$DayMonths0
ProverRoom    SAVEVALUE   BookingsAll+,1
              ASSIGN      6,V$DayTabCol1                     ;Number of the column in bookings database
; modeled by the matrix MX$Booking, where it is recorded the date of the first overnight
              ASSIGN      7,V$DayTabCol2                     ;Number of the column in bookings database
; modeled by the matrix MX$Booking1, where it is  recorded  the date of last night
              ASSIGN      Room,1                             ;Number of the booked hotel room
TestRooms1    TEST G      MX$RoomList(P$Room,2),0,DrugR
              TEST L      MX$RoomList(P$Room,1),X$WorkWeeks,DrugR
              TEST E      MX$Booking1(P$Room,P6),0,DrugR
              TEST E      MX$Booking12(P$Room,P7),0,DrugR
```

Fig. 1 Parameters of generated GPSS transactions

```
              ASSIGN      Room,1                             ;Number of the booked hotel room
TestRooms1    TEST G      MX$RoomList(P$Room,2),0,DrugR
              TEST L      MX$RoomList(P$Room,1),X$WorkWeeks,DrugR
              TEST E      MX$Booking1(P$Room,P6),0,DrugR
              TEST E      MX$Booking12(P$Room,P7),0,DrugR
              MSAVEVALUE  RoomList+,P$Room,1,1
              MSAVEVALUE  Booking1,P$Room,P6,V$Day1TabM1      ;Booking  the room - 1st roomnight
              MSAVEVALUE  Booking12,P$Room,P7,V$Day2Bookings  ;Record the 2nd roomnight
              SAVEVALUE   Roomnights+,P3                      ;Count of the roomnights
              SAVEVALUE   RoomReven+,MX$RoomList(P$Room,2)    ;Sumarize the room revenues
              TRANSFER    ,EndBookBook
DrugR         TEST L      P$Room,X$Rooms1Available,DrugoKrilo
              ASSIGN      Room+,1                            ;Looking for another room in the same sector
              TRANSFER    ,TestRooms1
*********************************
DrugoKrilo    ASSIGN      Room,V$Krilo2                      ;Room in 2nd sector
TestRooms2    TEST G      MX$RoomList(P$Room,2),0,DrugR2
              TEST LE     MX$RoomList(P$Room,1),X$WorkWeeks,DrugR2
              ASSIGN      RoomKr2,V$RoomKr2
              TEST E      MX$Booking2(P$RoomKr2,P6),0,DrugR2
              TEST E      MX$Booking22(P$RoomKr2,P7),0,DrugR2
              MSAVEVALUE  RoomList+,P$Room,1,1
```

Fig. 2 Searching and Booking room

Besides the parameters of transactions in Booking module the modeling algorithm shall also apply the following options of GPSS World [7]:

Functions. Following GPSS Functions are used in the basic algorithm modeling Hotel RMS:

DayMonths – describes the number of the days of every month of the year;

MonthSummer – Probability Distribution to generate requests for the month set P1 (months 5 and 9 - probability is set 0.10, month 6 - 0.20, and months 7 and 8-30% probability). Given the various statistics on the flow of tourists, the function may change;

DaysFromBeg – Sets day of the beginning of the year in the month recorded in the P1 parameter (May – 120, June – 151, July – 181, August – 212, September - 243).

Matrices. In the synthesized simulation models mainly is used the matrix MX$*RoomList* which models the list of the rooms in the hotel. Each row of the table corresponds to the room in the modeled hotel. The matrix has the following columns:

- Number reservation;

- Price per night in the room. If set to 0, this means that the room is under construction or prohibited to hire.

MX$*Booking* - in a row number - the room number in the column Number of the week record date of the first overnight;

MX$*Booking2* - in a row number - the room number in column number the week number is recorded when the last night is requested.

Variables. In the simulation models primarily are used the following variables:

DayMonths – calculates the months of the first night Requesting;

DayBook1 – calculates the date of the first night Requesting;

DayBook2 – calculates the date of the last overnight Requesting;

Day1TabM1 – calculates the date of the first night in the days since the beginning of the year;

DayTabM2 and *DayTabCol1* – calculates the column's number in the table with reservations MX$Booking, where it is recorded the first overnight Requesting;

DayTabCol2 – number of the column in the table with reservations MX$Booking, where it is recorded the last overnight Requesting;

DayMonths0 – for clearance of the days when calculating last overnight Requesting;

Krilo2 – calculates the number of the first room in the second available sector;

Krilo3 – calculates the number of the first room in the third available sector;

Krila1and2 and *Krila* and *RoomKr2* and *RoomKr3* – auxiliary variables for calculating the number of rooms in the cycle to check availability at available sectors;

OccupRoomN – calculates Occupancy rate [6, p.43]: Occupancy_roomnights = (Number_of_roomnights/Number_of_rooms_available_for_sale)*100% ;

ADRroomnights – calculates Average daily rate (ADR) [6, p.45]: ADR_roomnights = Room_revenues/Number_of_roomnights.

Cells. In the synthesized simulation model are used the following cells serving as counters:

X$WeekOpen – Initial value 120 - number of days since the beginning of the year before the opening of the hotel;

X$BookingsAll – total number of generating GPSS transactions during the modeling;

X$BookingsEject – total number of transactions, which are not found available at the requested date, recorded in P1 and P2;

X$BookRooms – total number of transactions, leaving the model served and booked rooms in the matrices MX$Booking and MX$Booking2;

X$Roomnights – total number of booked roomnights;

X$WorkWeeks – number of weeks, in which the hotel is open;

X$RoomReven – total sum of revenue from overnight books;

X$Rooms1Available – initial number of available rooms in the first hotel sector;

X$Rooms2Available / X$Rooms3Available – initial number of available rooms in the second/third hotel sector.

The results of the synthesized algorithm of the modeled hotel RMS can be observed in standard Simulation windows in GPSS World: SaveValues Window, Blocks Window, Matrix Window, etc. Fig. 3 shows the SaveValues window in the standard GPSS report created in Extended Editor. It can be seen the calculated value of X$RoomReven at the end of the simulation.

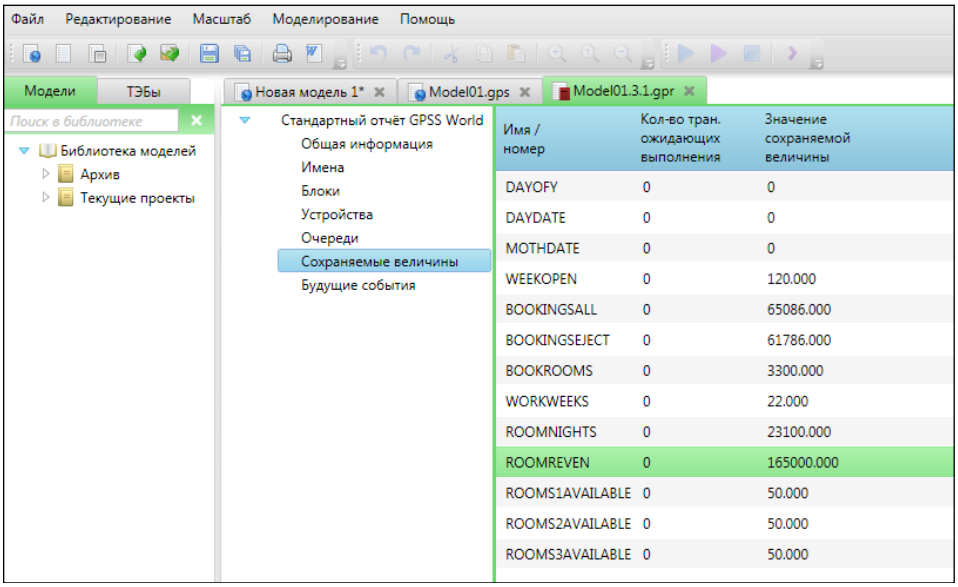

Fig. 3 SaveValues Window

In the developed model can be added and other parameters of the generated GPSS transactions, which can be set according to [8]: Type of accommodation (business, relax, etc.); Type of hotel guest; Level of interest in relaxation hotel services; and other characteristics of tourists and the tourist flow that affect the formed final hotel revenue.

Another extension of GPSS World is Universal editor of forms presented in [3]. GPSS Extended editor and Universal editor work together. Universal editor of forms provides richer opportunities to demonstrate the operations of the various systems and algorithms: special forms for monitoring the dynamics of change in the performance of the model during the simulation; constructing scenarios for 2-D animation; automated building plans of experiments on selected factors and limits their amendment; interactive analysis of the results of the experiment in dynamic forms, animated recording of the simulation and change patterns during the experiment to selected numeric system attribute of GPSS model; the existence of a database of input data and the results of experiments.

4. Conclusion and future work

The most important task in the development of any industry is the assessing of the system performance, which finally is used to solve practical problems. The simulation modeling allows conducting preliminary studies to assess: characteristics of the system: throughput, probability of service, time service; economic indicators, such as revenue and expenses and more. Project activities are aimed not only to development of theory, methodology and practice of computer experiment in recreational industries, but also in socio-economic studies and tasks of the governance of Bulgaria.

The presented model of Hotel RMS is planned to be expanded and improved in several aspects: Adding parameters for a detailed description of bookings of tourists; Adding GPSS World facilities (and other capabilities / options) and code fragments, modeling other hotel services, creating hotel revenue, according to [8]: wellness studio, restaurant, bar, etc.; Creating a library with typical elementary blocks to automate labor in the creation of new

models; Adding fragments of calculating costs; Adding fragments to determine the overall picture for (future) state of the hotel - in determining the development strategies. Therefore, we are planning constructing parametric simulation models of an infrastructure and services in the hotel.

Work on the simulation models of Hotel RMS poses as a general objective, the creation of experimental centers and the development of models of experimental economics and the determination of effective directions for development. Creating complete and autonomous simulation applications and make them available to business is the ultimate goal of modeling in the field of recreation industries.

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Basics of Management for Cloud Computing Security (part 2 Physical Security)

Nedko Tagarev

UNWE, Sofia, Bulgaria
ntagarev@e-dnrs.org, ntagarev@gmail.com

Abstract. This article is continuation of series of such for management of cyber security. The problem that is observed is management of physical security in cloud environment. This article indicates connections between law, standards and policy for physical security. The main threats and defence mechanisms in cyber security (physical aspects) related to the clouds are described. Thus this article represents a review of basics, which contains some analyses, and models for physical security.

Keywords. Cloud computing, Cloud security management, Cyber security, Cyber security management system, Physical security

1. Introduction

The main **problem** of this article is almost total neglection of physical security when it's come to cloud computing. This is because a lot of people and organizations believe in technical, technological or software solutions of the security problems. By the management point of view there are polices procedures, economic and management processes that are more important for prevention and proactive approach to the cyber security issues.

The other problem that this article can be assigned to is that often the measures designed to meet one particular physical security goal or threat may not address others.

This article targets only the management part of physical security in the sites. There are no technical or technological requirements for elements of the security – for example how high the guard have to be, or what kind of CCTV or locks have to be in the site.

2. What is physical security?

Definitions

In Chapter 1: Physical Security Challenges". *Field Manual* **Physical security** is defined as that part of security concerned with physical measures designed to safeguard personnel; to prevent unauthorized access to equipment, installations, material, and documents; and to safeguard against espionage, sabotage, damage, and theft.[1]

Other definition that can be found is by Margaret Rouse that states Physical security is the protection of personnel, hardware, software, networks and data from physical actions and events that could cause serious loss or damage to an enterprise, agency or institution. This includes protection from fire, flood, natural disasters, burglary, theft, vandalism and terrorism.[2]

The definition that is given by The Free Dictionary is that part of security concerned with physical measures designed to safeguard personnel; to prevent unauthorized access to equipment, installations, material, and documents; and to safeguard them against espionage, sabotage, damage, and theft.[3]

Security features

Complex system – the system of physical security contains many elements and connections between them. They can be technical or technological, human related, human activities, and policy or economical related;

Complicated system - It is not known how the change of one element of the system will affect the other elements of the system. Requires impact analyses;

An indivisible system – The elements of the system are interconnected and cannot be considered separately even for cost reasons;

Component problem - the weakest security point is the weakest link in the chain of security system;

Cascade effect – in case of security breach there are inevitable or unforeseen chain of events that can affect security system. Requires *impact analyses*;

Dynamic (changeable, active, proactive) system - a system that constantly changes, according to emerging of the new threats or technologies;

Subjective - depends on what security elements are prioritized, what analysis (often risk analysis and assessment) is used, who did the analysi

s (programmers and mathematicians often ignore cyber security elements that are not related to malicious code or cryptography). Prioritize threats (phishing or DDoS attacks). Most of the *risk analyses* are based on heuristic methods or expert opinion;

Costly – every element in security system cost money. There is no revenue for money invested in security but there are benefits. This requires *cost-benefit analyses*.

Example: On October 21, 2016, multiple distributed denial-of-service attacks (DDoS attacks) target systems operated by Domain Name System (DNS) provider Dyn, which caused major Internet platforms and services to be unavailable to large swathes of users in Europe and North America.

As a DNS provider, Dyn provides to end-users the service of mapping an Internet domain name when, for instance, entered into a web browser to its corresponding IP address. The DDoS attack was accomplished through a large number of DNS lookup requests from tens of millions of IP addresses. The activities are believed to have been executed through a botnet consisting of a large number of smart devises connected to the internet infected with Mirai malware.

Mirai is malware that turns networked devices running out of date versions of Linux into remotely controlled "bots" that can be used as part of a botnet in large-scale network attacks. It primarily targets online consumer smart devices.

Actually DDoS attacks don't harm the data its confidentiality or integrity but the access. This attack is targeting the accessibility of business processes as the main idea is to stop them for some period of time. This period depend on system recovery capabilities of company. [4] According to these popularized by media attacks the main financial resources for security (cyber security) goes for protection from DDos attacks. The effect of this prioritization can be seen in the next example:

Example: Cyber attack by the WannaCry ransomware cryptoworm, which targeted computers running the Microsoft Windows operating system by encrypting data began on Friday, 12 May 2017, and within a day was reported to have infected more than 230,000 computers in over 150 countries, parts of Britain's National Health Service (NHS), Spain's Telefónica, FedEx and Deutsche Bahn were hit, along with many other countries and companies worldwide. Actually ninth months earlier such attacks occurs but nobody (public media and the cyber security managers that are informed by them) notice it because of "Dyn attacks".

This type of attack targets all the elements of information security process confidentiality, integrity and access. Again the main problem is prioritization but there we can see another one – training of the personal. In the next pages of this article this problems will be explained in details. Again the solution is **backup** or also known as **system recovery**.

Physical security policy

Physical security policy includes (most of them are included in ISO standards*):

- Physical security standards;
- Physical security management and responsibilities;
- Assessment of the actives;
- Evaluation of the actives;
- Access to the actives(for the personnel);
- Identification and authentication(for the personnel);
- Security procedures;
- Accident report procedures;
- **Security zones**;
- **Traffic control**;
- **Permanent analyses of information**;

***Note:** ISO standards are not mandatory by any means, but they give a good standing point.

Assets of the organization (company) – there are some actives that have value so they requires protection. Value may be measured by financial or other metrics. In corporation culture there are three main actives – finances, reputation and law. [5]

Classifications of the threats for physical security by origin (there are included all the treads that can harm directly and indirectly security).

From nature; Bad weather (wind, rain, cold, heat), Earthquakes, Hurricanes, Tsunami, Hail, Snow, Emotion, Landslides, Crushing, Floods, Forest and field fires, Parasites, Contagious diseases, Epidemics, Lightning storm, Fog, wild or domestic animals("bug in the system"), etc.

Technogenic threats are those that come from man's industrial activities. For example they can be – gas leak, chemical spill, poisons, dirt, fires, crushing, landslides, dangerous working environment, radiation, stopping of electricity, floods, communication breakdowns, heating or cooling, etc.

There are other threats that involve physical security like – **space threads**, **social threads**, **terrorism, media, organized crime, IT threats that harm physical security, Human threats, political threads** or **military threats**.

According to information security or cyber security some of those threats sound strange and inappropriate but in some scenarios they can play a major part in the security breach. The other instrument that includes "strange plots" or risks with very low probability is *scenario analyses*.

Example: On December 23, 2015, the Ukrainian Kyivoblenergo, a regional electricity distribution company, reported service outages to customers. The outages were due to a third party's illegal entry into the company's computer and SCADA systems: Starting at approximately 3:35 p.m. local time, seven 110 kV and 23 35 kV substations were disconnected for three hours. Later statements indicated that the cyber attack impacted additional portions of the distribution grid and forced operators to switch to manual mode. The outages were originally thought to have affected approximately 80,000 customers, based on the Kyivoblenergo's update to customers. However, later it was revealed that three different distribution oblenergos (a term used to describe an energy company) were attacked, resulting

in several outages that caused approximately 225,000 customers to lose power across various areas.[6]

Actually in this example there is no physical breach in the site, but it's a problem for the physical security. In the context of the article no computer can work without electricity and that applies in all means for cloud storage sites.

Example: US data centers consumed about 70 billion kilowatt-hours of electricity in 2014, the most recent year examined, representing 2 percent of the country's total energy consumption, according to the study. That's equivalent to the amount consumed by about 6.4 million average American homes that year. This is a 4 percent increase in total data center energy consumption from 2010 to 2014, and a huge change from the preceding five years, during which total US data center energy consumption grew by 24 percent, and an even bigger change from the first half of last decade, when their energy consumption grew nearly 90 percent.[7]

For all the physical treats that the site can be vulnerable the most important are **threats that came from humans**.

There can be made a huge list of vulnerabilities, threats and risk and we can make few examples - dishonest employees, poor trained or bad selection of employees, errors in the execution of the operations, carelessness employees, poor hygiene requirements, self-confidence, curiosity, apathy, domestic problems and etc. All these aspects are vulnerable to *social engineering*, which is totally neglected in most of the cases according to cyber or information security.

3. Physical security in cyber security

Physical protection of the site

The main goals for physical security are:

- Detect potential intrudes;
- Detect intrudes;
- Trigger response.

These goals are supplied by measures - physical barriers, natural surveillance, security lighting, alarm systems and sensors, video surveillance, mechanical access control systems, electronic access control systems, identification systems and access policies, security personnel.

If we talk about IT system or IT site all these measures can be join to IT infrastructure. As it said before these security measures don't bring revenue. In such cases there have to be implemented some analyses – evaluation of *Capability Maturity Model (CMM) and cost-benefit analyses*.

Access control to data and physical protection

Without proper hardware protection, access to operating system and data – circumventing authentication and authorization – may be possible. Thus, proper physical protection is an essential part of information security.

Physical access threw hardware can give potential access to:

- Operating System;
- Application Software;
- Data.

Common practice or defence mechanism in these cases is encryption.

Other often implemented measures in data and operating centres, computer systems (hardware):

- Premises and room protection by perimeters (fences, sliding doors with access control card readers, security guards, CCTV, etc.);
- Restricted physical access permissions per premises, area, and room;
- Hardware in locked racks or locked away when not observed;
- If sensitive, hardware (containing sensitive data) may not be moved out of controlled area;
- Secure disposal of hardware, when not in use anymore.[8]

When it comes to physical breach to security the **location** is very important asset. The main vulnerabilities depends on several factors like –*size of the site, number of sites, number of employees, number of access points, location of data center or date storages also location of IT infrastructure.*

4. Physical security in cloud computing

In these part of the article have to be compared main issues in cloud security defined by some of the biggest cloud providers and points of attack that can be used in physical security breach.

In The Top 5 cloud security threats presented by Mark Russinovich[9] we can see these problems divided in three main sources:

1. Outsider;
2. Insider;
3. End users.

The threats are divided by:

5. Malicious insiders – several mitigations like background check, *"don't trust them with everything"* only access that is needed to perform the job ***(note**: they are talking about digital access)*. Risk rate is close to low;

4. **Data breach – concerning physical security, somebody takes a hard drive and try to take it out of data center**. There are all the physical security measures including biometric access devises. All the devices that are carried out are destroyed or cleaned from data (That's implemented in Microsoft physical security). The question that is raised is in thousand of hard drives are it possible for someone to target the exact one that he is searching for? Risk rate is *"not much of a threat".* Also there is discussed **man in the middle** threat – but this is not a problem of this article;

3. **Data loss** – concerning deleting the data by user or **natural disaster**. Response to this treats are multiple duplication in different regions (3 copies), snapshot backup. Risk rate is very close to low;

2. **Insufficient due diligent** - not included as a problem for this article. Risk rate is very high;

1. **Account hijacking** - not included as a problem for this article. Risk rate is very high.

In Addressing the Top Five Cloud Security Challenges by ORACLE, by Naresh Persaud[10] he defined this problems:

1. **Data access from mobile devises** - not included as a problem for this article;

2. **Access control and identity management** - not included as a problem for this article;

3. **Ongoing compliance concerns**- not included as a problem for this article;

4. **Co-mingling of customer data**- not included as a problem for this article;

5. **Security standards and certification**- not included as a problem for this article.

The ORACLE response to these threats by inside-out approach and by implanting security measures in every layer of data storage or application. They are focusing on managing the risks.

Week points and common points of possible attack

There will be placed a list of weak points considering vulnerabilities (they includes all the aspects of physical security):

- Sensitive information carriers towed in the trash;
- Not secured portable hardware;
- Not secured sensitive information carriers;
- Public access to the organization hardware;
- Publicly accessed data carriers;
- Open doors;
- Glass doors or windows;
- Easy to open doors;
- Easy to access doors without entering trough them;
- There is no access control;
- There is no identification control;
- There are no personnel that control the access;
- Personal of the site is not suspicious to strangers;
- Natural disasters resistance of the site;
- Suspended ceilings, ventilation shafts;
- Lack of electricity, water or other supplies;
- Easy access to alarm system;
- etc. literally thousands.

Good practices and protection measures

In many aspects, private companies that are intensively using cloud structures in their business adopt and implement different cyber security strategies to reduce the risks of breakthroughs. However, the security of the cloud is often undermined, as aspects of physical security are neglected.[11] Organizations and institutions handling information related to critical infrastructure, government bodies, etc., measures to improve physical data security are more robust and use all modern security mechanisms.

Measures related to physical access to server premises

Physical and cyber security teams need to work together to have better forecasting, threatening threats, or lessening threats to cloud structures. The main strands that need to be taken into account for the physical security of the site / building in its entirety are:

• CCTV systems;
• Intrusion alarm systems;
• Physical barriers;
• Detection systems for perimeter monitoring;
• 24-hour security and control of the physical access of all the entrances and exits of the particular site;
• Metal detectors, other electronic or electromechanical instruments;
• Emission of alarm signals from the I/O system in addition to physical security;
• Control of the access of individuals, outside the organization and their inspection by the Physical Guard, whether the inspection will be performed with a visual inspection or by technical means;

• A person's access regime in the facility, which regulates the days and times in which the object can be visited by individuals individually or by escorting by the security officer of the information;

• Different points that require employees to use an access card after passing the physical guard;

• Identification, control and restriction of access to certain areas for employees.

The creation of effective methods to counteract threats to the physical security of cloud structures, especially those who store data and classified information, follow the logic of a set of measures and tools to prevent timely or interfere with unauthorized access or attempts for unauthorized access to classified information, as well as the establishment of an organization for the timely identification and counteraction of breaches of established physical security measures of Classified information.

In addition to setting up a system for controlling the access of persons outside the organization, particular attention should be paid to vulnerable sites and threatened sites, creating conditions for unauthorized access to classified information. Such places may be windows with or without visual supervision, with or without grids, positioning relative to the site's floor, doors in the facility with or being visually supervised, other openings that can be used for unauthorized access, and so on. Consideration is also given to the possibility of unauthorized penetration by the roof, using lightning conductors, available external pipes, railings, trees or other buildings.

In the context of physical access to persons outside the organization (here the threats and physical access of persons from the organization itself are excluded), variations in access are applicable, but according to the methodology for building and assessing the physical security systems of classified information of the Bulgarian State Security Commission Information, the visit mode requirements on the site where classified information is stored are limited to[12]:

Visits with security escort

The nationality of the visitor, the level of access in his authorization, the limitation of access to classified information, and other requirements arising from the risk of unauthorized access is decisive in determining whether that person will move with or without security at the site.

Visits without security escort

1) The mode of visit is defined by an order by the head of the organizational unit with the help of the information security officer.

2) Visitors must be accompanied throughout their stay at the facility. If a visitor has to visit more places or employees, he can be referred to the appropriate person, along with the necessary instructions.

3) A register shall be maintained with the visitors' identification data and information on the location and time of their visits.

Visits without control

This visit mode can only be used in the administrative area under Article 14 (1) (2) of the Ordinance on the system of measures, means for the physical security of classified information and the conditions and procedure for their use. Visitors entering without guards should be marked. This way of identification is effective only if all other employees also bear designations. A register of visitors' credentials and information on the location and time of their visits must be maintained.

Viewed from another side, the security of the room where the servers are stored is determined by the site security area according to the organization's regulatory documents, depending on where classified information is created, processed, stored, or distributed, such

as the main groups of security zones. The State Commission on Information Security defines the following basic zones:

SECURITY AREA CLASS I security zone in which information classified as "Confidential" or higher is created, processed, stored or provided in a way that provides direct access to that information upon entry into the area.

SECURITY AREA CLASS II: Class II security zone is an area in which information classified "Confidential" or above is created, processed, stored or provided in a way that does not allow direct access to that information upon entry into the zone. [12]

The zone model can be applied to zones with the same level of thrust. This method basically is used for managing the network security. This is fundamental security concept.

Change of the hardware or application is controlled by so called change management. The good practices are described in ISO 27002:2005:

- Identification and recording of significant changes;
- Planning and testing of changes;
- Assessment of the potential impacts, including security impacts, of such changes;
- Formal approval procedure for proposed changes;
- Communication of change details to all relevant persons;
- Fallback procedures, including procedures and responsibilities for aborting and recovering from unsuccessful changes and unforeseen events. [13]

5. Conclusion

The first conclusion that can be made is that physical security is not only protection of the site. It can be vulnerable to other threats that came from other sources. To incorporate this in management of security there are several methodologies that are used – *impact analyses, consequence analyses, risk analyses, heuristic analyses, cost-benefit analyses, scenario analyses.*

Second – the attacker has not to make a site breach. He can harm some of the supplies that are needed for working without interruption.

Third – social engineering is totally neglected instead of prioritized common attack like phishing, DDoS and etc.

Insider threats are very interesting topic. On one halve of the problem when the issues are connected to IT the company, organization etc. have to use IT specialists with IT knowledge. On other side they have at least the basic knowledge how to breach IT security system. This topic gets more interesting if these professionals get physical access to the site.

Probably the main principle that is accepted as a procedure is “four eyes principle”.

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Economic Aspects, Problems and Trends in Cloud Computing Development

Violeta Kraeva, Petia Emilova

D. A. Tsenov Academy of Economics, Svishtov, Bulgaria
kraeva@uni-svishtov.bg , petiaem@uni-svishtov.bg

Abstract. The result of the implementation of the business model of cloud computing is expressed in two main aspects of performance - lowering the costs and increasing the profit. Putting the focus on economic efficiency of application of the cloud model for access to various information resources, the report explores and systematizes the direct and indirect benefits to its application in business. Some risks and problems that accompany the use of cloud services are presented as well. The most important trends that characterized the development of cloud services are pointed out.

Keywords. Cloud computing, Benefits, Problems

1. Introduction

The strength and power of cloud computing makes it a megatrend that is growing with great speed and transforms the organization and business model. They have a huge potential in the current business environment. Very often their application is the best option to solve complex corporate tasks for which the potential of their IT infrastructure does not have enough power and capacity. Together with substantial economic benefits, an important argument for the use of cloud computing for many companies is the ability to access data from anywhere in the world with Internet connectivity.

Cloud computing is a new tool on which basis managers can do quick assessment of the current business state and take action to improve its organization. They are the basis for implementation of innovative solutions and flexible business management. Cloud model allows to determine the cost of IT services in the enterprise with high accuracy. In this sense, some analysts define the cloud model as a fourth type utility after water, energy and telephone connection.

This new approach for information processing and use unconditionally leads to transformation not only of the business itself, but also its ideology. Cloud computing creates prerequisites for its development, increase its innovation potential and the level of management informatization. Cloud office, cloud ERP, CRM and BI systems are already reality in many large companies. The number of representatives of small and medium businesses who choose cloud solutions also constantly growing.

The aim of this report is to study the economic potential of cloud computing for businesses, and to identify problems and trends in their application as well.

2. Problems and trends in cloud services

Cloud computing radically change the business, and ways of interaction between customers, partners and employees of the companies. They are central for the business strategies development. According to research by Oxford Economics, conducted with 350 company executives, 71% of them claim that the model "Cloud" is a component of their long-

term vision for the business in 2015-2016. Moreover, the results show that the penetration of cloud technologies in the new markets has increased by 50% for the past two years. So cloud solutions gain increasing worldwide attention and popularity as one of the most important and leading methodologies in the delivery and use of IT services.

The deployment of cloud solutions facilitates faster response to changes both within the company and the surrounding business environment. This is especially critical for large companies with complex management processes. Through cloud technology it is easily to overcome the difference between growing needs of business and the limited capacity of the corporate IT infrastructure. This is especially true for small and medium sized enterprises that do not have sufficient financial and human resources. In many cases, the introduction of cloud released cash resources that could be directed towards the development of innovations.

Along with the outstanding benefits of cloud computing, there are some risks and problems associated with such radical technological changes. The most important of these relates to data security. It stems from the need to transmit confidential information to third parties. There is a risk and the likelihood of unlocking cloud services in cases of force majeure, such as natural disasters, degradation of internet connection or hacker attack.

Protection of information against unauthorized access and safety of the cloud as a whole can be achieved by introducing a special set of hardware and software measures such as:

- creating encrypted channel for data transmission between the physical computer and the remote IT resources located in the cloud;
- duplicating all power systems, Internet channels, server and network equipment;
- weekly backups of all customer data to another physical remote location;
- daily copy of the most important customer data encrypted and directed by customer location.

Secondly, the transition to cloud infrastructure can lead to reduction of staff in the IT department.

The third problem is the technological dependence of the company on the provider of cloud services. The switching to the cloud itself can be a difficult and painful for the company.

The lack of legal productions on determining the responsibility of cloud services provider is definitely an obstacle to widespread use of cloud computing. It is necessary to clarify the conditions for licensing the supplied software as a service. The existing common psychological barrier also negatively affects the willingness to move to cloud solutions.

Continued engagement of cloud technologies with the needs of businesses generates new ideas for consolidation of individual enterprises under a unified information system based on the cloud. This is so called Industrial cloud or industrial Facebook. The essence of this idea is to create a universal platform for cooperation between providers and users of cloud services. This kind of information platform will facilitate interaction between manufacturers, retailers and customers.

Many IT experts foresee dynamic development of cloud services over the next few years and it is expected that they will become major computer services. Moreover, the trend is that IT will transform into a function of the business, its mandatory and integral component. Experts from Gartner and Forrester research companies predict that cloud computing will be the focus of technological progress. The public cloud service and platform as a service will have the greatest potential.

The interest in cloud computing model is not only a global trend, but there has been significant growth in Bulgaria. According to a survey of key IT initiatives among managers of companies in different sectors, 44% of them plan the introduction of cloud services in 2014-2015 and 27% of enterprises, mainly in the manufacturing and trade sectors, have already implemented "Software as service" cloud model.

It has already proved that cloud services have unlimited opportunities for business development. The migration to the cloud enables companies to discover new delivery channels, marketing and sales, new sources of revenue to implement innovative business models and seek new sources of growth. Cloud services are a tool for achieving competitive advantages, for adapting to changes in business environment and more effectively manage customer relationships. It is easier to identify critical issues of the company through them and define a new strategy for its development.

Cloud technologies are innovative future technologies that today are already available in countries like USA, Japan, Germany and others. They have huge potential and will become no alternative solution for small and medium sized enterprises. A long lasting interest and increased demand for cloud services is yet to form. Our country takes its first steps in this direction and they will be successful if are based on already accumulated knowledge and experience.

3. Analysis of the economic potential of cloud computing

The result of the new organizational model of cloud services has two main aspects of efficiency - reducing costs and implementing or increasing profits. When the main focus is economic efficiency of using the cloud model, it is necessary to examine all the benefits (direct and indirect) for the business. The most significant of them we find the following:

1. **The computer infrastructure becomes a commodity** at retail and with pricing models resembling those of the sale of various utilities (electricity, water, etc.). The effectiveness of this product is achieved by the five characteristics of cloud services:
   a. precise measurement of the used services, which means that customers have the opportunity to pay only for the used resources;
   b. broad network access services, which means that cloud services are accessed via standard protocols and tools;
   c. automated self-service, which means that each user can reserve the needed resources automatically, without the intervention of the supplier;
   d. pooling of distributed resources, which means that the supplier combines distributed resources and transfer them for use from one user to another in accordance with their needs;
   e. rapid elasticity, which means that the cloud is adjusted according to customer needs - enables rapid allocation of necessary resources and their automatic release.

2. **Economies of scale.** This type of benefit is achieved primarily by the provider of the cloud service and is a consequence of unification and the provision of multiple distributed resources and especially the possibility of their evenly distributed loading.

Real economies of scale resulting from the aggregation of the various customer workloads that are not the same for different industrial solutions. Solutions like ERP, CRM, SCM and others. represent workloads that have different daily, weekly and monthly peak values. The combination of the loads of various customers or other industrial solutions lead to a higher degree of utilization of the infrastructure and more effective integration of resources, as well as to lower cost per unit of infrastructure.

The benefit for customers is in transferring the capacity problems (need for significant capacity at peak hours of loading and inefficient load during the rest of time) and using discounts for large volumes of power, servers, storage and network infrastructure. Experience shows that with the exception of power, these purchases are single and somewhat rare bring savings.

3. **Transformation of capital expenditure into operational**. This is perhaps the most important benefit of using cloud services and it is implemented mainly for the user organization. Significant capital resources, necessary to purchase expensive technical devices and software systems, employing highly qualified IT staff, staff training and more, are replaced with operating costs to pay for the actual consumed quantities of IT resources. Uncommitted investment funds can be used for various other purposes.

4. **Reducing the total cost in the short term**, which is reflected in the complex pattern of costs including capital costs, corporate architecture costs, the costs of technology, personnel, organizational costs, management costs and others. IT resources in organizations are not equally loaded at any time of day, week and month. The use of cloud services completely eliminates the costs for resources maintenance when they are not used to a certain moment.

5. **New business opportunities**. The use of cloud services creates opportunities for business to rapidly adapt to changing business environments and markets which indirectly affects to change the competition. They affect the ways of doing business, including - how to reach new customers more effectively, respond to new market requirements, better serve customer relationships, etc.

6. **Transfer the Risk of exact resource planning**. User organization released one of the most complex and risk management tasks associated with the precise planning of necessary IT resources. The risk of the exact resource planning is transferred to the cloud service provider. The characteristic "rapid elasticity" of the cloud service, which means that the used amount of resources can be quickly and easily adapted depending on the current needs and requirements, creates consumer illusion that he has access to unlimited volume of computing resources.

7. **Increasing business flexibility** is a benefit with off-full importance having in mind the dynamics of the modern business environment. Rapid elasticity, broad network access to a wide variety of combined resources generate opportunity for faster and cheaper adapting to market dynamics, the ability to quickly change business processes, accelerate innovation, direct impact on competitiveness.

8. **Encouraging innovations**. Cloud services facilitate and encourage organizations to launch new initiatives, as the risk and losses in the event of failure are much lower than usual level. Experience shows that progress is achieved by trial and error. Cloud services enable rapid verification of ideas, testing new business functionality (specific software) pilot new applications and components, testing new sales techniques, i.e. provide multiple trial and error until reaching a satisfactory outcome at the lowest possible cost, money and time. And all this in terms of: hardware resources used for processing and storage; platforms and tools to develop applications; plenty of software solutions and applications that end users can use. In practice, organizations will explore and examine the potential of much more ideas as a result of which the time and the means to verify the unsuccessful ideas will decrease, and the opportunities for improving business operations through the implementation of successful ideas will increase.

9. **Promote the use of green technologies.** Standardized and efficient cloud infrastructures are characterized by reduced total energy consumption and therefore carbon

emissions. At this stage this is only true for the biggest cloud service providers who can realize economies of scale and well distributed loading only in the short term. After building a large-scale cloud infrastructure it can talk to a real green technology.

4. Conclusion

The study of the economic potential of cloud services business model reveals many opportunities for direct and indirect benefits in terms of: transforming computing infrastructure into a commodity; economies of scale; transforming capital expenditure into operational; reduce total costs in the short term; new business opportunities; transfer of risk associated with the proper planning of resources to a third party; increase business agility; stimulating innovation in organizations; encouraging the use of green technology and more.

Although "from an economic point of view cloud services promise an exceptional business flexibility and reduce costs in the short term," according to leading experts, this can not be true. "Virtually there is no two identical organizations, and this requires careful economic analysis, informed in terms of legal and other aspects. "

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Analysis of Industrial Enterprises' Cash Flows

Rositsa Ivanova

UNWE, Sofia, Bulgaria
Rosi_Ivanova@abv.bg

Abstract. The analysis, evaluation and management of cash flows take an important place in the common methodology for financial and business analysis of enterprises' overall activity. The information about the amount, composition, structure and dynamics of cash flows, in general and by types of activities, is of key importance for the financial management to make substantiated and correct decisions for the regular realization and development of the operating activity, for capital structuring, for making investments and, in general, for the development of business in operational and strategic aspect. This study highlights the cash flows, and the methodology for analysis of industrial enterprises' cash flows with the use of excel is the subject matter of the study. The goal of the study is to achieve theoretically justified and business friendly and feasible methodology for analysis of industrial enterprises' cash flows.

Keywords: Cash flows, Excel, Methodology, Analysis, Management

1. Introduction

At present, the issue of the analysis and evaluation of cash flows is underestimated. The owners of capital and the business in general, are mainly interested in the achieved profits, the opportunities for its increase, the return of the funds they have invested and the business efficiency.

The analysis of cash flows plays a key role and is of crucial importance in the common methodological scheme of the financial and business analysis of the enterprises. The analytical information obtained allows evaluating the overall activity of the enterprises from the industrial sector in the country. On this base, management decisions for improvement of the capital structure, increase of investing activity and efficiency of operating activity, for achieving and maintaining financial and market stability and financial equilibrium of the enterprise in operational and strategic aspect can be made.

2. Formulation of the issue

An enterprise can close the reporting period with profit, however not having any cash or having limited amount of cash. A fact that has negative effect on the enterprise's liquidity and solvency. This is due to the application of the accounting principle of accruals, according two which revenue and expenses are recognized and stated in the financial result for the period they have occurred in, irrespective of the fact that cash has not been received yet, has not been paid.

The information about cash and their movement are interesting for external users. Shareholders, investors, creditors, staff, government authorities, etc. need information about the time of collection of receivables from sales, i.e. about the time period during which they become cash. The main source of cash required for the ordinary course of the financial and operational cycle of the enterprise is namely the cash generated from the enterprise's operating

activity. In order to guarantee the ongoing liquidity and the long-term solvency of the enterprise, it needs to generate positive net cash flow from its operating activity. The excess of cash inflows over the cash outflows from operating activity is an important prerequisite for the enterprise to fulfill its obligations and to maintain regular business relations with its partners and the state.

The issue of generation, movement, use and allocation of cash in time, both in aggregate and by types of activities, is very important for the internal users of information – owners, financial management, and in general the management of the industrial enterprises. They are quite interested in the information about the amount of net profit from operating activity and the net cash flow from the same activity, and the ratio between them. Provided the net profit from operating activity increases more quickly than the net cash flow from this activity, or provided it has a negative value, the reasons for this should be found and attention should be focused on analyzing the financial position of the clients, on establishing an effectively operating system for collection of receivables from clients, on analyzing the period for collection of receivables by sales, and on other actions.

Both external and internal users need information about the generation of cash flows from the investing and financing activity of the enterprise. Cash flows from these activities show the way in which the enterprise's activity is financed. The movement of cash from financing activity characterizes the sources for financing the business – own capital or borrowings. This means that the cash flows from this activity should be related to the capital structure shown in the liability section of the balance sheet.

The cash inflows from investing activity also show how business is financed. For example, as a result of disposition of fixed tangible assets cash inflows from investing activity are formed. However, here comes the important issue of the reasons for the disposition of fixed tangible assets. Provided some difficulties exist for the performance of the ordinary activity of the enterprises, in its nature, the disposition of assets is a prerequisite for the occurrence of conditions for their insolvency and bankruptcy. On the other hand, the cash outflows from investing activity, in their nature, are the investment policy of the enterprise. The balance between cash inflows and outflows from these activities affects the formation of net cash flow from all activities of the enterprise.

3. Information provision for the analysis

The information needed for the analysis is contained in the statement of cash flows. Enterprises prepare the statement of cash flows according to the requirements of the applicable accounting standards establishing the international and national provisions in the country.

The statement of cash flows should represent the cash flows of the enterprise during the reporting period classified as cash flows from operating, investing and financing activity.

There are two methods for preparation of the statement of cash flows – direct and indirect.

The national accounting provisions, and in particular accounting standard 7 "Statements of Cash Flows", set out that the enterprise's statement of cash flows should be made according to the direct method.

According to the direct method, cash flows from different types of transactions made by the enterprise are stated in different activities by main classes of gross cash proceeds and gross cash payments for the reporting period. For this method, the information about gross cash proceeds and payments can be obtained in accounting way. The enterprise's accounting registers for the movement of cash are the main source of information. One can also use the information about the amount of items of the balance sheet of the enterprise, whereas taking

in consideration all changes in these items that have occurred as a result of transactions for which no cash has been used.

In its nature, the direct method for preparation of the statement of cash flows shows the cash proceeds and cash payments in their full amount. This allows the modeling of the enterprise's future cash flows from operating activity by analyzing and evaluating their rhythmicity in time, stability and sufficiency for financing and administering the investing and financing activity of the enterprise.

The international standards for financial reporting (IFRS) recommend the direct method for preparation of the statement of cash flows. The indirect method for preparation of the statement of cash flows is provided as an alternative, which is based on adjusting the amount of the book or accounting profit and its transformation and presentation as the net change of cash and cash equivalents during the reporting period.

The statement of cash flows made according to the indirect method provides important information for the analysis of cash flows of the enterprises, both in general and by types of activities.

4. Methodology for analysis of cash flows

The methodology for analysis of the enterprise's cash flows is a combination of information for the analysis, used analysis methods and stages of the study carried out is specific order. A system of absolute and relative indicators is used for the analysis of the enterprise's cash flows.

The methodology for analysis of the enterprise's cash flows provided the statement of cash flows is prepared according to the direct and the indirect method is presented on figure 1.

In terms of the analysis of cash flows, provided the statement of cash flows is prepared according to the indirect method, the attention of the financial management should be focused on important relations and dependencies between different components of the balance sheet, the statement of cash flows and the profit and loss account. Here we speak about the profit from operating activity and the net cash flow from the enterprise's operating activity. At the same time, the net revenue from sales, the cash inflows from clients, the profit from sales and the profitability of sales are quite interesting. The methodology for analysis of the net cash flow is also of crucial importance.

The methodology for analysis of the enterprise's cash flows, provided the statement of cash flows is prepared according to the indirect method, is presented on figure 2.

The methodology for analysis of the enterprise's cash flows is very important within the general methodology of the financial and business analysis. Furthermore, cash flows may be considered from two aspects. On one hand, the net cash flow, both generally and by types of activities, is studied as a resultant indicator formed under the influence of a system of factors, and on the other hand, cash flows are a factor affecting other important resultant indicators. For example, cash flows are part of the system for financial equilibrium, respectively disequilibrium, of the enterprise, and are thus a factor affecting its formation and maintenance.

The opportunities provided by information technologies for the business analysis of the overall activity of the enterprises are of great interest.

To our opinion, based on the information from the statement of cash flows, we can model the vales of absolute and relative indicators for analysis of cash flows. This allows, by using different functionalities of EXCEL, to develop worksheets where the input information has been taken from the different elements of the enterprise's annual financial statements. This information is processed in terms of the method for defining the values of the cash flow analysis indicators.

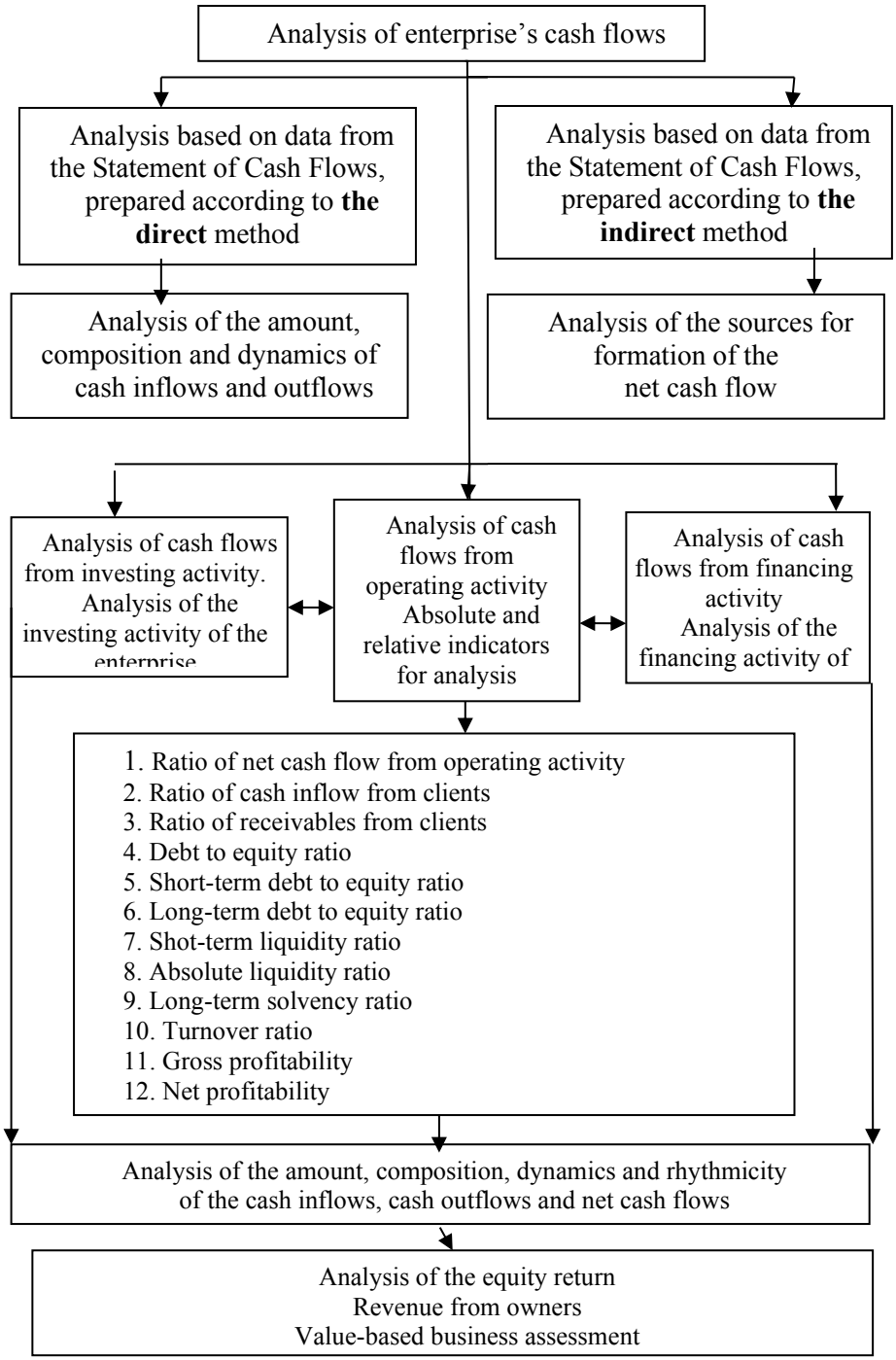

Fig. 1. Methodology for analysis of enterprise's cash flows

Different versions for solutions may be modeled and proposed on the basis of which the financial management could make a decision in terms of the respective issue areas.

The methodology for analysis of cash flows is tested according to data about the business of the industrial enterprise Zeta OOD.

The information from the statement of enterprise's cash flows is presented in table 1.

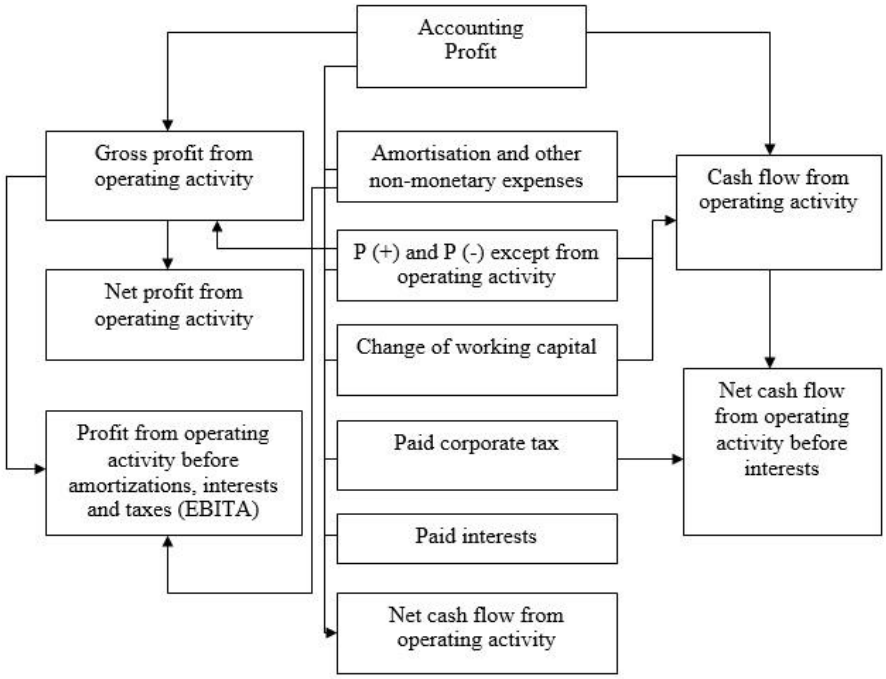

Fig. 2. Transformation of accounting profit

On the basis of this information, we can analyze the amount, composition and dynamics of cash flows both by types of activities and in general for all activities carried out by the enterprise. Based on the data in the table, the following conclusions can be made:

1) The cash available at the end in comparison to the beginning of the current period has decreased with BGN 578 thousand.
2) The net cash flow of the enterprise for the current in comparison to the previous year has decreased with BGN 1598 thousand. The following direct factors have affected such decrease:
    a) changes in the net cash flow from operating activity;
    b) changes in the net cash flow from investing activity;
    c) changes in the net cash flow from financing activity.
3) The net cash flow from operating activity at the end in comparison to the beginning of the current period has increased with BGN 27 thousand, which is due to the decrease of the cash proceeds with BGN 9200 thousand, and due to the decrease of cash payments with BGN 9227 thousand.

4) The net cash flow from investing activity has decreased with BGN 1995 thousand, which is due to the decrease of the cash inflows from such activity with BGN 2350 thousand, and due to the decrease of the cash outflows from the same activity with BGN 355 thousand.

Table 1 (BGN'000)

Indicators	Previous year	Current year	Change (+, -)
1. Cash at the beginning of the period	1790	2810	1020
2. Cash from operating activity, including:			
a) proceeds	28450	19250	-9200
b) payments	25180	15953	-9227
c) net flow	3270	3297	27
1. Cash flows from investing activity, including:			
a) proceeds	4983	2633	-2350
b) payments	355	0	-355
c) net flow	4628	2633	-1995
4. Cash flows from financing activity, including:			
a) proceeds	1600	2520	920
b) payments	1400	1950	550
c) net flow	200	570	370
5. Change in cash flows, including:			
a) proceeds	35033	24403	-10630
b) payments	26935	17903	-9032
c) net flow	8098	6500	-1598
6. Cash at the end of the period (indicator 1 + indicator 5 c)	9888	9310	-578

5) The net cash flow from financing activity has increased with BGN 370 thousand due to the increase of cash proceeds with BGN 920 thousand and the decrease of payments related to this activity with BGN 550 thousand.

Table 2 summarizes the information from the statement of cash flows, the balance sheet and the profit and loss account of the enterprise. On the basis of the above data the values of the relative indicators for analysis of the enterprise's cash flows are calculated. We speak about the indicators characterizing the indebtedness, the level of absolute liquidity, the turnover of the net cash flow from operating activity and the profitability of the enterprise's net cash flow.

Table 3 presents the calculations of values of the respective relative indicators. On the basis of the data in this table, the following conclusions can be made:

1) The ratio of receivables from clients has increased and at the same time the ratio of cash inflows from clients has decreased. This means that there is a delay in the collection of receivables from clients.

2) The short-term debt to equity ratio on the basis of the net cash flow from operating activity has decreased.

3) The ratio of turnover of the net cash flow from operating activity has increased, which means that its turnover rate has been also increased. I.e. a cash flow of BGN 1 achieves higher amount of net revenue from sales.

Table 2

Indicators	Previous year	Current year	Change (+, -)
I. Input data from the statement of cash flows, BGN'000:			
1. Net cash flow from operating activity	3270	3297	27
2. Cash inflow from clients	28450	19250	-9200
II. Input data from the balance sheet, BGN'000:			
3. Receivables from clients	6850	12100	5250
4. Equity	60000	60000	0
5. Borrowings, including:	30000	28000	-2000
a) short-term payables	15200	13400	-1800
b) long-term payables	14800	14600	-200
III. Input data from the profit and loss account			
6. Accounting profit	1900	2100	200
7. Book profit	1800	1950	150
8. Revenue from operating activity	122800	125100	2300
9. Net revenue from sales	120900	123290	2390

4) The gross, respectively the net profitability of the net cash flow from operating activities, have increased.

The following conclusion may be made in terms of the enterprise subject to analysis in the report: the efficiency of use of the net cash flow from operating activity has been increased.

Table 3

Additionally calculated indicators	Previous year	Current year	Change (+, -)
1.Ratio of receivables from clients, BGN (from table 2 – indicator 3: indicator 9)	0,0567	0,0981	0,0415
2.Ratio of cash inflow from clients, BGN (from table 2 – indicator 2 : indicator 9)	0,2353	0,1561	-0,0792
3.Ratio of net cash flow from operating activity, BGN (from table 2 – indicator 1 : indicator 8)	0,0266	0,0264	-0,0003
4.Ratio of repayment of obligations, BGN (from table 2 – indicator 1 : indicator 5)	0,1090	0,1178	0,0087
5.Debt to equity ratio based on net cash flow from operating activity, BGN (from table 2 – indicator 5 : indicator 1)	9,1743	8,4926	-0,6817
6. Debt to equity ratio, BGN (from table 2 – indicator 5 : indicator 4)	0,5000	0,4667	-0,0333
7.Shot-term debt to equity ratio based on net cash flow from operating activity, BGN (from table 2 – indicator 5a : indicator 1)	4,6483	4,0643	-0,5840
8.Ratio of turnover of the net cash flow from operating activity, BGN (from table 2 – indicator 9 : indicator 1)	36,9725	37,3946	0,4221
9.Ratio of liquidity of the net cash flow from operating activity, BGN (from table 2 – indicator 1 : indicator 5a)	0,2151	0,2460	0,0309
10.Gross profitability of net cash flow from operating activity, % (from table 2 – indicator 6 : indicator 1)	58,1040	63,6943	5,5903
11.Net profitability of net cash flow from operating activity, % (from table 2 – indicator 7 : indicator 1)	55,0459	59,1447	4,0988
12.Average amount of cash, BGN'000	5839,00	6060,00	221,00
13.Ratio of absolute liquidity, BGN (from table 2 – indicator 12 : indicator 5a)	0,3841	0,4522	0,0681
14.Ratio of absolute liquidity, BGN:			
a) at the beginning of the current year, BGN (indicator 6 table 1 : indicator 5a table 2)	x	0,6505	x
b) at the end of the current year, BGN (indicator 6 table 1 : indicator 5a table 2)	x	0,6948	x
c) change (indicator 14b – indicator 14a	x	0,0442	x

5. Conclusion

The presented methodology for analysis of cash flows of the enterprise allows achieving the objective and main tasks set for the analysis.

The aim is to suggest a theoretically substantiated and practically feasible methodology for analysis of the cash flows of every enterprise.

The tasks of the analysis are as follows:

1) To analyze the efficiency of the enterprise's operating activity. This means to analyze and evaluate the enterprise's operations, which ensure cash inflows from operating activity and whether the cash inflows from this activity are in sufficient amount and security in time to ensure the operating activity. Furthermore, the analysis should identify and evaluate the efficiency of the management of the cash inflows and outflows from the enterprise's operating activity, whereas observing the time periods for repayment of the ongoing obligations. The maintenance of sufficient amount of working capital is of crucial importance here.

2) To analyze the efficiency of the enterprise's investing activity by evaluating the amount and structure of investments made in fixed tangible and intangible assets, as well as the long-term investments.

3) To analyze and evaluate the efficiency of the enterprise's financing activity. Here it is of crucial importance to evaluate the enterprise's abilities to maintain both its equity and the borrowings used for the business.

This means to identify, evaluate and correctly manage the activities for payment of incomes to owners, dividends, repayment of loans, etc.

4) To make general value assessment by means of using value-based methods for business evaluation, this should integrate the obtained analytical information about the movement and the condition of the cash flows in general and by types of activities.

Using the HTTP/2 Server Push Technology to Reduce Web Page Loading Latency

Pavel Petrov, Stefka Petrova

University of Economics - Varna, Varna, Bulgaria
petrov@ue-varna.bg , s.petrova@ue-varna.bg

Abstract. The paper reviews the factors affecting latency when loading web pages. It concludes that nowadays network bandwidth plays an increasingly small role about the latency. An empirical research was made to find out how much the latency is reduced when using the HTTP/2 server push technology. An average by volume and by content web page is used in the tests, which includes different versions of the protocol HTTP - HTTP/1.1, HTTPS/1.1 and HTTPS/2. Experimental software is created and an external program to simulate network latency is used.

Keywords. Server Push, HTTP, HTTP/1.1, HTTP/2, Hypertext Transfer Protocol, web page, latency, lag, web server, web client.

1. Introduction

As it is well known, the HTTP protocol works at the application level according to the model Open Systems Interconnection (OSI) ISO [1] and the exchange of data between client and server is done in classical request-response manner. The original protocol HTTP, known as HTTP/0.9 [2], is maximally simplified and was suitable for the technological level in the 90 years of the last century. Currently servers that support virtual hosts based on names should not support HTTP/0.9, according to the latest standard for HTTP/1.1 [3] and in fact most web servers today do not support it. Messages exchanged between the two sides look like as those shown in Table 1. The network connection between client and server is interrupted after every response, which requires when sending subsequent requests to open a new network connection.

In the next version of the Protocol - HTTP/1.0 [4], established in 1993 and standardized by IETF in 1996, the request became more complicated by adding new parts - the first line stays, it became so-called start-line, and header and body are added. On the start line, unless the keyword GET, can be used other words indicating the manner in which the server can handle the request. These keywords are known as methods and in HTTP 1.0 there are GET, POST and HEAD methods. Additionally, after the address of the document the protocol and version should be specified.

GET method remains the primary means of requesting documents, but it has no body. In contrast, the POST method has a body and it can convey large amounts of data to the server. HEAD method is similar to the GET, except that the server does not need to return the body of the response, only the header. This is most commonly used for validation of hyperlinks, availability of resources or checking when the document was last modified.

Server-side response in HTTP/1.0 compared to HTTP/0.9 is also complicated and consists not just of the requested document, but also status line and header are added. The status line begins with data for protocol and version, followed by the code status - a three-digit number, and possibly status message. The header contains some system data concerning the

information contained in the message body. The network connection between client and server is interrupted again after each response.

Table 1. Sample client request and server response using different versions of HTTP

Version	Sample Request	Sample Response
HTTP/0.9	GET / [\n]	<html> <head><title>Sample Title</title></head> <body>Sample Web Page Content</body> </html>
HTTP/1.0	GET /img.jpg HTTP/1.0 Referer: /index.html [\n\n]	HTTP/1.0 404 Not Found Content-Type: text/html Content-Length: 17 [\n\n] Object not found.
HTTP/1.1	GET /img.jpg HTTP/1.1 Host: www.example.com User-Agent: Mozilla/5.0 (Windows NT 6.1; rv:47.0) Gecko/20100101 Firefox/47.0 Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8 Accept-Language: bg,en-US;q=0.7,en;q=0.3 Accept-Encoding: gzip, deflate Connection: keep-alive [\n\n]	HTTP/1.1 404 Not Found Accept-Ranges: bytes Cache-Control: max-age=604800 Content-Encoding: gzip Content-Length: 606 Content-Type: text/html Date: Sun, 23 Oct 2016 08:51:37 GMT Etag: "359670651+gzip" Expires: Sun, 30 Oct 2016 08:51:37 GMT Last-Modified: Fri, 09 Aug 2013 23:54:35 GMT Server: ECS (ewr/1445) Vary: Accept-Encoding X-Cache: HIT x-ec-custom-error: 1 [\n\n] [the binary data which follows in the body of the response are not presented here]

Unlike HTTP/0.9 which lacks header, in HTTP/1.0 it plays a very important role, as there are a lot of useful information: indication of what type of data are sent in the body (field Content-Type), what is the size (field Content-Length), how the data are encoded (field Content-Encoding), when the document was changed (field Last-Modified) and others. Messages exchanged between the two sides look like those shown in Table 1.

The next version of the protocol HTTP - version HTTP/1.1 was established in 1997 (RFC 2068), renewed in 1999 (RFC 2616) [5] and is undergoing final changes in 2014 (RFC 7230 - RFC 7240). The most interesting pointc are: the request and the response retaining the basic structure of 3 parts; in the request header is added mandatory field "Host:" to allow the usage of virtual hosts; provides an opportunity to maintain open network connection (Field Connection: Keep-Alive) for extended periods of time and use it for other requests- responses; ability to send just part of a file; the number of codes for the status increases significantly; possible fields in request headers and response headers also increased significantly. Messages exchanged between the two sides look like those shown in Table 1.

As was shown, the HTTP protocol to version 1.1 goes through evolutionary development intended to enrich its capabilities while maintaining somewhat compatibility with previous versions, as far as possible. Because the protocol is textual, it can be easily tracked, especially the contents of system parts - request header and response header. The

body, which in most cases constitutes the essence and contents of the data exchanged, is possible to be compressed. Unfortunately this greatest advantage - the textual nature of the protocol, is its biggest drawback when talking about reducing the volume of transmitted data.

2. Capabilities of HTTP/2 to Reduce Latency and Lag While Loading Web Pages

Latency is a general term with a broader meaning in informatics, meaning the time delay in the execution of an operation. In terms of computer network latency incorporates latency that occurs during data transmission, processing and presentation to the end user. Often latency was called lag when it comes to overall subjective feeling of latency in interactive work with the system running in online mode.

For latency contribute many independent from each other factors and it can be represented as the sum of the time for preparation of the message by the client side plus the time it takes a signal to travel through the physical media (fiber optic cables, radio waves, electrical signals, etc.) plus time for signal processing in the intermediate devices plus the time required for processing the message from the server side, generating response, sending it back to the client and again plus time for way back from the server to the client, plus the time required by client to process and eventually visualize the response.

In the computer network in which there is relatively low traffic the latency will depend mainly from the speed of propagation of the signal, which is limited by the laws of physics - the speed of light in a vacuum (about 300000 km/s). In case of LAN where client, server and intermediate devices are relatively closely located, the latency can be as low as 1-2 ms. In an environment of a global network where client and server are at large distances from each other, the latency may exceed 500 ms.

Not like this is the issue where the computer network has a relatively large traffic close to the maximum throughput of the bandwidth. In such cases, intermediate devices start buffering packets or start seeking for other routes and unfortunately part of the data may be lost. So a major share of latency starts to play another factor - the processing time in the intermediate devices. Particularly unfavorable impact of lag, as a subjective feeling of latency, is data packets loss. This loss can occur due to various reasons and cannot directly related to latency, but for whatever reason a data packet is lost the subjective feeling of the user is not good. In such cases, when eliminating the cause of packet loss, the lag is reduced.

We can summarize that the determinants of lag are: bandwidth of the computer network, its current load, the distance between the two sides of the communication link, the packets loss problem, and the ability to quickly process data from the server and from the client. In recent years, bandwidth plays an increasingly small role in reducing lag. Data from studies worldwide show that the average speed is about 6,3 Mbps per connection, which means that many users have access to high-speed Internet connection and bandwidth no longer is the major limiting factor while loading web pages [6]. Accordingly, other factors have a greater impact on reducing latency and lag. One of them is the protocol.

The main issue before the HTTP/2 is that the precedents are synchronous. They require the client to wait the server to return the entire response and after then may submit a new request. In this mode of operation if the server slowly generates any of the resources, it effectively blocks all subsequent communication. To overcome this problem most browsers simultaneously open multiple network connections to the server in order to receive multiple resources simultaneously (for example Google Chrome opens simultaneously 6 network connections). HTTP version 2 is trying to solve the problems associated with latency by optimizing the way the resources are requested and send. It differs significantly from protocol

versions 0.9/1.0/1.1 - it is not synchronous, but asynchronous; not textual, but binary; it using only one TCP/IP connection to the domain through which performs multiplexing, i.e. transmission of multiple data streams simultaneously. The latter is achieved as each pair of request-response is associated with its own stream and therefore the data must be sent divided into individual frames [7]. Frames associated with a certain flow and thereby through a network connection may be transmitted to a plurality of data streams. The flows are relatively independent of each other, so blocking occurred of any response or application does not interfere with the other streams. Thus multiple requests-responses can be executed simultaneously and streams can be prioritized.

The protocol HTTP/2 supports the ability to compress headers. This is not done by classical algorithms for data compression, but through organizational technique, the use of which provides no resending for header fields already have been sent. For this purpose the client and the server support tables of sent and received fields in the headers and their values. Another important feature of HTTP/2 is the ability the server to send resources that were not explicitly requested by the client (server push technology). These resources are cached on the client side for future use. The server can start sending these resources as soon as a connection has been established, without even waiting for the client to send a request. In this operating mode it is possible to increase unnecessary network traffic, but as overall the web pages will load faster.

3. Reducing the Lag Using the HTTP/2 Server Push Technology

According to worldwide data from httparchive.org for the first 500 thousand most visited sites for a period of one year to 15/10/2016 (according to Alexa rank), to fully load and display an average web page it takes about 102 requests for resources, and the average volume a fully loaded web page is about 2,3MB [8].

In order to empirical research the lag reducing when loading web pages using HTTP/2 server push technology, we created a test unit through which to identify lags at different levels of network latency. An important feature when using HTTP/2 is that modern browsers support version 2 only if the connection is encrypted, although this is not specifically required under the standard.

During the testing we used components with the following characteristics: operating system - Windows 7 32 bits; processor - i5-2430M; RAM - 4GB; web server - Apache 2.4.18; web browsers - Google Chrome 54.0.2840 and Mozilla Firefox 47.0.1 (the latest versions at October 2016).

Since the client and the server are physically located together on one machine to simulate network latency we are using Google Chrome built capabilities.

When setting up a web server for handling HTTP/2 the instructions from the documentation of Apache are followed [9], namely - in the configuration file httpd.conf a directive of charging mod_http2 is activated, add a directive to switch from ver. 1.1 to ver. 2 is used:

LoadModule http2_module modules/mod_http2.so

Protocols h2 h2c http/1.1

Directives SSLCipherSuite and SSLProtocol were changed to support SSL v2 and v3 as follows:

SSLCipherSuite ECDHE-RSA-AES128-GCM-SHA256:ECDHE-ECDSA-AES128-GCM-SHA256:ECDHE-RSA-AES256-GCM-SHA384:ECDHE-ECDSA-AES256-GCM-SHA384:DHE-RSA-AES128-GCM-SHA256:DHE-DSS-AES128-GCM-SHA256:kEDH+AESGCM:ECDHE-RSA-AES128-SHA256:ECDHE-ECDSA-AES128-SHA256:ECDHE-RSA-AES128-SHA:ECDHE-ECDSA-AES128-SHA:ECDHE-RSA-

AES256-SHA384:ECDHE-ECDSA-AES256-SHA384:ECDHE-RSA-AES256-SHA:ECDHE-ECDSA-AES256-SHA:DHE-RSA-AES128-SHA256:DHE-RSA-AES128-SHA:DHE-DSS-AES128-SHA256:DHE-RSA-AES256-SHA256:DHE-DSS-AES256-SHA:DHE-RSA-AES256-SHA:!aNULL:!eNULL:!EXPORT:!DES:!RC4:!3DES:!MD5:!PSK

SSLProtocol All -SSLv2 -SSLv3

In conducting tests we following the next approach: the web server is stopped; the appropriate settings are carried out and then start again; the resource is loaded three times in order to "warm up" the system and then into the new "incognito" windows the resource is freshly loaded; we repeated the tests in both browsers three times, then times are averaged for each of them.

The program module that generates a web page which in turn pushes additional resources is performed by the interpreter to PHP 7 and is as follows:

```
<?php
$PUSH = 1; //0 - Push Off; 1 - Push On
$files = 102;
$size = 23; //KB
$latency = 0; // milliseconds
if(!isset($_GET['t'])) {
        if($PUSH)
                for($i=0; $i<$files; $i++)
                        header("link: <$_SERVER[PHP_SELF]?t=$i>; rel=preload; as=script",
false);
        print<<<EOT
<html>
<head>
<script>
var begin=0, end=0, delta = 0;
function print(s) {
        document.getElementById("txt").innerHTML += (Date.now()) + ":" + s + "<br />";
}
document.addEventListener("DOMContentLoaded", function(event) {
        begin = Date.now();
        print("DOMContentLoaded");
});
window.onload = function () {
        end = Date.now();
        print("load");
        print("delta="+(end-begin));
}
</script>
</head>
<body>
<div id="txt"></div>
EOT;
        usleep($latency*1000);
        echo "<script>print('START: $files files, $size KB');</script>\n";
        for($i=0; $i<$files; $i++) echo "<script src='?t=$i' async></script>\n";
        print<<<EOT
```

```
</body>
</html>
EOT;
} else {
        usleep($latency*1000);
        echo "print('$_GET[t]'); tmp = '" . str_repeat("1234567890", $size*100) . "';";
}
?>
```

In the variables $files and $size accordingly can be set how many additional resources need to be requested to full visualization of the website and what is their size. Additionally, the variable $latency can be set, which can simulate the performance of more processing on the server side while returning the resource. In conducting the tests we set the values of these variables as close as possible to reproduce the average web page, according to the aforementioned statistical survey from httparchive.org - a web page that loads additional 102 resources totaling 2,3MB.

In Table 2 shows the time interval in seconds from the time of loading of an average statistical web page until the load of all the resources necessary to visualizing (lag) using push and not using push technology.

Table 2. Lag depending on the protocol and push technology

Technology	**Browser**	
	Google Chrome 54.0.2840	**Mozilla Firefox 47.0.1**
HTTP/1.0	0,5 s	0,5 s
HTTP/1.1	0,4 s	0,6 s
HTTPS/1.1	0,5 s	0,8 s
HTTPS/2 no PUSH	0,3 s	0,2 s
HTTPS/2 with PUSH	0,2 s	0,1 s

We think that in the data provided essential is not the absolute values, but rather ratios between them. In some of the tests better performs one of the browsers and this is not essential. The more interesting is that in general HTTP/2 has speed advantage compared to his predecessors. Using push technology also give a speed gain compared to scenario not using push.

4. Conclusion

HTTP protocol goes a long way in its development. The new version 2 has many advantages and should be adopted in practice fast. Our experiments shown that reducing the lag is achievable goal by using HTTP/2 server push technology.

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Classic and Intelligent Methods for Multi-Criteria Decision Analysis and Their Implementation in Software Environment

Stanislava Klisarova-Belcheva

Plovdiv University Paisii Hilendarski, Plovdiv, Bulgaria
stanislava_belcheva@gmail.com

Abstract. The paper begins with a state of the art review of modern methods of multi-criteria decision making, suitable for business analysis in economics and management. The characteristics of some contemporary software systems for solving multiple-criteria evaluation problems are analyzed. Based on our specification, we propose a feasible design of a new information system to support decision makers via both exact and fuzzy performance matrices. The developed software prototype is verified by solving the task of business intelligence software selection.

Keywords. Multi-criteria decision making, software for multi-criteria decision analysis, business intelligence system.

1. Introduction

In recent years, the rapid pace of technological and economic development has led to a need for solving complex problems focused on decision-making in many areas of science, technique and economics. In times of economic crisis and strong competition organizations are experiencing increased demand for fast and reliable algorithms for decision making, a significant part of the problems being multi-criterial.

The aim of the paper is to create and present a new interactive information system for decision support in multi-criteria problems employing classical and modern methods for ranking of alternatives.

To accomplish this goal we have to solve the following tasks:

- Analyze and compare basic algorithms for multi-criteria decision analysis and the existing software products for their implementation;
- Create an architecture of decision support software through precise and fuzzy estimate models;
- Develop a prototype of an interactive decision support system working with exact and fuzzy criteria, and weights for analysis of alternatives;
- Approbate performance of the new software system for solving the problem of selection of business intelligent system.

The main contribution of this work focuses on proposing a new architecture and in development of a relevant prototype of an interactive software that helps provide group solutions through alternative methods for multi-criteria decision analysis (MCDA) and their combinations. A specific feature of the proposed software is its ability to work both with exact and fuzzy assessments, to input them in an interactive way or calculate them by the most commonly used methods for determining their significance. The presence of a module for sensitivity analysis of the provided solution allows for minimizing the influence of subjective factor. In the future, we plan to create an additional module dealing with combined assessments of alternatives and weights - real numbers, fuzzy estimates and relations.

The second part of the report provides a brief overview of classic and modern algorithms for MCDA. The features of software products for MCDA automation are described and their functionalities are compared. The third part of the work is devoted to the proposed structural model of a new software product for group decision-making and the sequence of actions to reach ranking with respect to each of the preferred algorithms for MCDA. In the next part of the work the results obtained by using the new prototype are analyzed. For this purpose, we solve the problem for business intelligent system (BIS) selection and the results obtained are compared with those presented in the works of other authors. In the last part of the work, conclusions are provides and a plan for future work on the topic is proposed.

2. State of the art

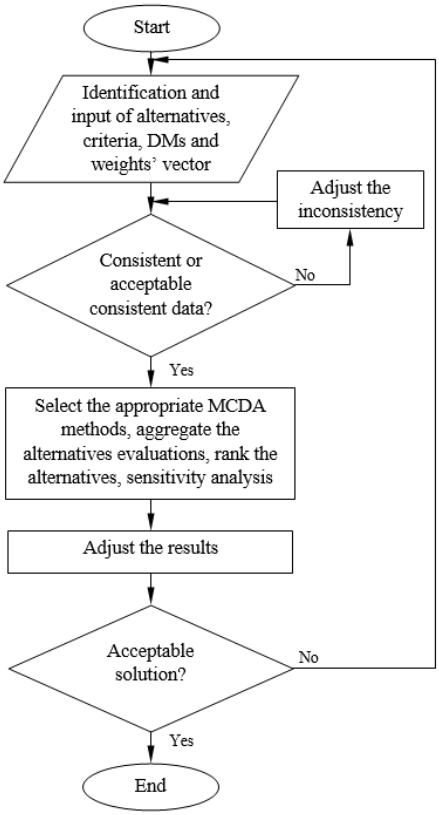

Fig. 1. Multi-criteria decision procedure

The task for group multi-criteria analysis is as follows:

Given: a set of n alternatives $A = \{A_1, A_2, \dots, A_n\}$; a set of m criteria for alternatives comparison $C = \{C_1, C_2, \dots, C_m\}$ and alternative estimates according to criteria, given by one or several decision makers (DMs).

To find: the order of alternatives ranking from "the best" to "the worst", or a subset of "the best" alternatives in some sense.

The main stages of multi-criteria decision making (MCDM) are shown schematically in Fig. 1. In the flowchart, the process of solution finding can be split into two main parts. In the first part, which we call "problem awareness", we define the problem, identify available alternatives and criteria for their assessment, DMs, and the hierarchy of criteria and their importance (by employing weight coefficients).

The second part of the decision process is analytical. Here we parse the actual situation, changing the weight coefficients, select and implement algorithms for MCDA, the obtained results are interpreted, and this cycle is repeated until we reach an acceptable solution.

In preparing the work we have used actual reviews of MCDA methods and have compared the classic methods such as Multi-Attribute Utility Theory (MAUT) and prospect theory of American school, ELECTRE and PROMETHEE from French school, AHP, heuristic methods, VIKOR, TOPSIS, MOORA, and many others [1, 2, 3, 4].

The most common algorithms for MCDA are evaluated in terms of time and space complexity, and transparency (for selecting a particular MCDM method for a specific problem). Following the analysis, the selected methods are classified into groups with similar

characteristics – for example, the least computational complexity group includes MOORA, VIKOR, and SAW, followed by ELECTRE, PROMETHEE, and DEMATEL, and in the group with most complex calculations are TOPSIS, AHP, etc. In terms of transparency we also can group the methods into three categories - the easiest in terms of explaining their economic sense are ELECTRE and MAUT, followed by VIKOR, and in the last group are AHP, TOPSIS, MOORA, etc.

Discussed and analyzed are also recent new fuzzy and hybrid models for solving multi-attribute problems such as fuzzy AHP, fuzzy TOPSIS, fuzzy VIKOR etc. to arrive the modern methods with interval-valued fuzzy set (IVFS), type-2 fuzzy set (T2FS), type-*n* fuzzy set, intuitionistic fuzzy set (IFS), interval-valued intuitionistic fuzzy set (IVIFS), fuzzy multisets, hesitant fuzzy sets [5, 6, 7].

In software design at this stage we plan to implement five classic method (AHP, DEMATEL, ELECTRE, TOPSIS, and VIKOR), and their fuzzy variants. The common feature shared by all of them is that they are widely used in various fields and enhance the effectiveness of the organizations. Preferred methods at this stage are created by different schools and respectively, based on various assumptions.

Analytic Hierarchy Process (AHP) first decompose their decision problem into a hierarchy of more easily comprehended sub-problems, each of which can be analyzed independently. The elements of the hierarchy can relate to any aspect of the decision problem – tangible or intangible, carefully measured or roughly estimated. Once the hierarchy is built, the decision makers systematically evaluate its various elements by comparing them to each other two at a time, with respect to their impact on an element above them in the hierarchy. In making the comparisons, the decision makers can use concrete data about the elements, but they typically use their judgments about the elements' relative meaning and importance. It is the essence of the AHP that human judgments, and not just the underlying information, can be used in performing the evaluations.

Making Trial and Evaluation Laboratory (DEMATEL) method is widely accepted as one of the best tools to solve the cause and effect relationship among the evaluation criteria. The method results in impact-relation map, revealing the interrelations among the criteria.

Using the family of methods ELimination Et Choix Traduisant la REalité, that means ELimination and Choice Expressing REality (ELECTRE) is realized in two stages: first, the construction of one or several outranking relations, which aims at comparing in a comprehensive way each pair of actions; second, an exploitation procedure that elaborates on the recommendations obtained in the first phase. Usually the ELECTRE is used to discard some alternatives to the problem, which are unacceptable. After that we can use another MCDA to select the best one. The advantage of using the ELECTRE before is that we can apply another MCDA with a restricted set of alternatives saving much time. Criteria in ELECTRE have two distinct sets of parameters: the importance coefficients and the veto thresholds.

The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) is a method of compensatory aggregation that compares a set of alternatives by identifying weights for each criterion, normalising scores for each criterion and calculating the geometric distance between each alternative and the ideal alternative, which is the best score in each criterion.The advantage of the method is that it provides a more realistic form of modelling than non-compensatory methods, which include or exclude alternative solutions based on hard cut-offs. Apart from that, the method is simpler and faster than AHP, SAW, etc.

VIseKriterijumska Optimizacija I Kompromisno Resenje, that means: Multicriteria Optimization and Compromise Solution (VIKOR) refers to a group of discrete methods of MCDA and seeks a compromise if there are several conflicting decisions. The method is

preferred because of its effectiveness as for general purpose tasks, and when the tasks are typical of a specific area. The basic idea of the method is to find alternatives with maximum utility and minimum shortcomings. A specific feature of the algorithm is that it generates not one but three indexes and they are analyzed together to reach ranking according to two rules specific to the VIKOR.

Currently there are dozens of MCDA software designed for commercial or research purposes. While academic software is free, the commercial software cost hundreds and even thousands of dollars even when using discount for educational purposes.

Current overview of the essential part of commercial MCDM software can be found in [8]. Here the group of multi-attribute decision-making (MADM) software includes 31 products, 3 of them are Web-based, and the rest are desktop applications. Most offer a convenient graphical interface - the weights and scores can be adjusted by dragging the computer mouse, and the effects can be seen immediately on several output windows, and the rest are just calculations tools [9].

Only in Bulgaria, in IICT-BAS as a result of years of effort of several teams were developed: MultiChoice, MCA-1 MCA-2 – software systems multicriteria analysis created under the guidance of prof. V. Vasilev; PROSYSMO, and subsequently WindPro – under the guidance of academician Popchev; BI-GDSS – under the guidance of prof. Borisova and others [10, 11, 12, 13].

Refering to the Website of The Comprehensive R Archive Network (CRAN) shows that, so far, by using the R programming language three packages for MCDA have been designed. In the first package, established in 2013, implemented is the method TOPSIS. Last year (2016), two packages for MCDM were created: Multi-Criteria Decision Making Methods for Crisp Data and Multi-Criteria Decision Making Methods for Fuzzy Data. In the first of two packages implemented were software methods RIM, TOPSIS (with two normalization procedures), VIKOR, Multi-MOORA and WASPAS. Built is also a meta ranking function, which calculates a new ranking from the sum of the rankings calculated, as well as an aggregated ranking. In the last package the same methods work with fuzzy data (triangular fuzzy numbers) [14].

Despite the large number of existing MCDA software, it should be noted that a significant proportion of them are no longer supported by developers, others are designed to implement specific methods and in fact can be used only by specialists or solve specific tasks. All this motivates us to create a prototype of a new information system for MCDA - Interactive Exact and Fuzzy (IEF) MCDA information system.

3. Architectural model of the new software system for group MCA

The architectural design of the new system for MCDA follows the usual pattern of a model-driven decision support system and includes four components: database, model base, knowledge base, and graphic user interface (GUI) (Fig. 2.).

The database stores the main data of the problem situation. This includes descriptions of alternatives, criteria and weight information, hierarchy of criteria, and evaluation of alternatives by criteria. The knowledge base contains the decisions about different problems by different methods, weights and hierarchy. Model database includes software implementation of various methods for MCDA – both classic and modern, combination of different decision techniques for criteria and its weights' selection, the opportunity to work with different types of estimates and weights, etc. The GUI allows the user to interact with the all software components like database, model base, and knowledge base.

The general diagram of the new software system architecture is shown in Fig. 3, presented are the designed interfaces and classes.

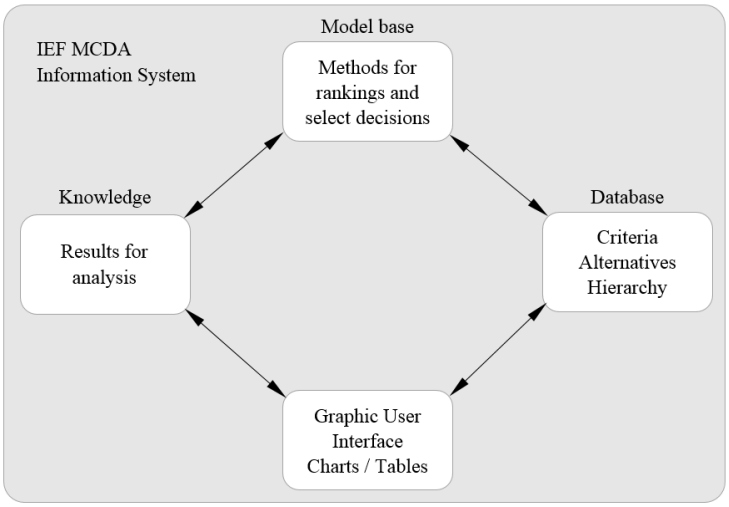

Fig. 2. Common architecture of the IEF MCDA IS

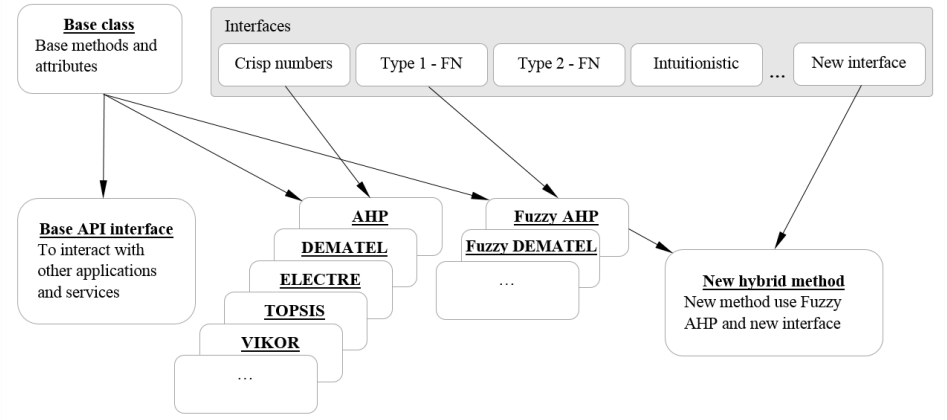

Fig. 3. Common structure of the new software system for decision-making

The proposed structure of the system shows that we plan to build an intelligent and expandable interactive information system through widening the basis of the models. The base model covers the models that perform the decision analysis described in Section 2 with algorithms for advanced decision making.

In the program implementation we follow the principles of procedural and object-oriented programming (OOP).

To guarantee system interoperability is provided a class, direct successor to the base class, to link with external applications. Defined is a specific API for connection to the core of the system. The class inheritance allows for usimng and upgrading of methods – for example TOPSIS overlays VIKOR adding comparison with the worst (least desired) alternative. The user can test hybrid method, which inherits existing and extends the new interface. The

proposed structure allows easy expansion of functionality as well as through the creation of additional modules within the IS and through libraries from external products.

The IEF IS prototype is implemented as a desktop application that can process input data in XML format with a predefined structure. The software provides components for visual and graphical analysis of results plus an option for instantaneous calculation when the parametetrst the solving of the problem depends upon are changed. The interface of the program also allows convenient comparison and recording the result of the various MCDA methods in graphical and tabular form, thus facilitating subsequent stages of processing and analysis.

4. Case study

To evaluate the performane of the new MCDA IS we consider the task for business information system selection. Interest in the topic is due, on the one hand, to the fact that over the past two decades, there are objective prerequisites for the growth of interest in the problems associated with the BIS. By means of automating business processes and reduce operating costs, information technology has become a tool for making informed decisions and achievieng competitive advantage in the market. On the other hand, it is a topical and significant area of intense research, and the interest in specific quantitative methods to evaluate BI systems is sustainably strong [15].

For the comparability of results obtained using the new system we solve multi-criteria task for BIS selection described by Ghazanfari et al. [16] and Rouhani et al. [17]. You are given five pre-selected BIS (called by the authors Evaluated Software, ES numbered I to V) and 34 criteria for their evaluation. We have to find the ranking of five given BIS using criteria. Selected criteria are evaluated using various BIS characteristics such as technology used (data warehouse, multi agents, intelligent agents, etc.), advanced data analysis (fuzzy decisions, dashboards/recommenders, alarms/warnings, web and mobile channels, data mining, etc.), modeling tools, interoperability (import and export data from/to other systems), etc. To solve the problem in two articles authors use fuzzy triangular numbers, whose membership function $\mu_{\tilde{a}}(x)$ is shown in Eq. 1.

$$\mu_{\tilde{a}}(x) = \begin{cases} 0 & x < a_1 \\ \frac{x-a_1}{a_2-a_1} & a_1 < x < a_2 \\ \frac{x-a_3}{a_2-a_3} & a_2 < x < a_3 \\ 0 & x > a_3 \end{cases} \quad (1)$$

Experts assess alternativesc variables from Table 1 and Fig. 4. For internal estimate representations, the authors use fuzzy triangular numbers under six grade scale.

Table 1. Linguistic variables and their corresponding fuzzy triangular numbers

Linguistic variable	Fuzzy numbers		
	a_1	a_2	a_3
Very Low (VL)	0	0	0.2
Low (L)	0	0.2	0.4
Medium Low (ML)	0.2	0.4	0.6
Medium High (MH)	0.4	0.6	0.8
Very high (VH)	0.6	0.8	1
Excelent (E)	0.8	1	1

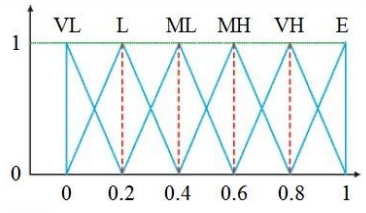

Fig. 4. Six grade scale for alternatives assessments with fuzzy triangular numbers

After applying the fuzzy TOPSIS, authors receive the following ranking:

ES *IV* (0.64) ≻ ES *V* (0.48) ≻ ES *I* (0.43) ≻ ES *II* (0.41) ≻ ES *III* (0.38) (2)

To check the reliability of the proposed algorithms, the data from the research referred to are used. We write the input data using an XML file, a fragment of which is shown in Fig. 5. The file includes alternatives, criteria, assessents and their weights as well as adjustments needed for the software to work properly.

```
<?xml version="1.0"?>
- <Problem>
    <GeneralOptions DisplayFormatACValues="0.0#"/>
    <ElectreOptions DisplayFormatCriteriaNormVal="0.####" DisplayFormatCriteriaVal="0.##" DisplayFormatMatrix5NormVal="0.######"
        DisplayFormatMatrix5MaxVal="0.######" DisplayFormatMatrix5="0.######" DisplayFormatMatrix4SumProduct="0.000" DisplayFormatMatrix4="0"
        DisplayFormatMatrix3="0.######" DisplayFormatMatrix2="0.######" DisplayFormatMatrix1="0.######"/>
    <AHPOptions DisplayFormatCCValues="0.###"/>
  - <Alternatives>
        <Alternative Color="4362996" Description="" Name="ES I" ID="1"/>
        <Alternative Color="4379124" Description="" Name="ES II" ID="2"/>
        <Alternative Color="4388072" Description="" Name="ES III" ID="3"/>
        <Alternative Color="4388031" Description="" Name="ES IV" ID="4"/>
        <Alternative Color="14152770" Description="" Name="ES V" ID="5"/>
    </Alternatives>
  - <Criteria>
        <Criterion Name="C01 - Group sorting tools and methodology" ID="1" CriteriaSearchType="1" CriteriaWeight="6" CriteriaType="1"/>
        <Criterion Name="C02 - Group decision-making" ID="2" CriteriaSearchType="1" CriteriaWeight="8" CriteriaType="2"/>
        <Criterion Name="C03 - Flexible models" ID="3" CriteriaSearchType="1" CriteriaWeight="6" CriteriaType="1"/>
        <Criterion Name="C04 - Problem clustering" ID="4" CriteriaSearchType="1" CriteriaWeight="4" CriteriaType="1"/>
        <Criterion Name="C05 - Optimization technique" ID="5" CriteriaSearchType="1" CriteriaWeight="2" CriteriaType="1"/>
        <Criterion Name="C06 - Learning technique" ID="6" CriteriaSearchType="1" CriteriaWeight="4" CriteriaType="1"/>
        <Criterion Name="C07 - Import data from other systems" ID="7" CriteriaSearchType="1" CriteriaWeight="8" CriteriaType="1"/>
        <Criterion Name="C08 - Export reports to other systems" ID="8" CriteriaSearchType="1" CriteriaWeight="8" CriteriaType="1"/>
        <Criterion Name="C09 - Simulation models" ID="9" CriteriaSearchType="1" CriteriaWeight="6" CriteriaType="1"/>
        <Criterion Name="C10 - Risk simulation" ID="10" CriteriaSearchType="1" CriteriaWeight="4" CriteriaType="1"/>
        <Criterion Name="C11 - Financial analyses tools" ID="11" CriteriaSearchType="1" CriteriaWeight="2" CriteriaType="1"/>
```

Fig. 5. A fragment from XML file with entire data

Due to the fact of using fuzzy numbers in the research referred to and the methods used by the new system with exact evaluations we convert the fuzzy triangular numbers into real numbers in compliance with the formula from Eq. 3:

$$f(\tilde{a}) = \sqrt{\frac{(a_1{}^2 + a_2{}^2 + a_3{}^2)}{3}} \quad (3)$$

The results obtained using the new system are shown in Fig. 6 and Fig. 7. The result achieved by using Fuzzy TOPSIS method in the developed prototype is absolutely identical to the results referred to in Eq. 1. When using VIKOR method there is a huge indiscrepancy but this is only at a first glance. Calculations using similar evaluations lead to small differences in the results leading to displacement of second and third, and fourth and fifth position. We can assume that this decision is also good because of the specificity of the algorithm, which focuses on proximity to the best solution, while TOPSIS measurement is performed by a coefficient that takes into account the proximity of the decision to the best and worst alternative.

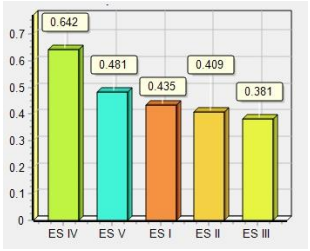

Fig. 6. Fuzzy TOPSIS ordering

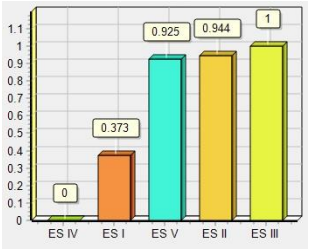

Fig. 7. VIKOR results

Fig. 8 and Fig. 9 shows the interactivity of the system before and after the change of weight coefficient following first criterion, which leads to exchanging the positions of ES II and ES V. The ability to quickly change the importance of the criteria and instant comparison of newly calculated values is among the largest advantages of the system.

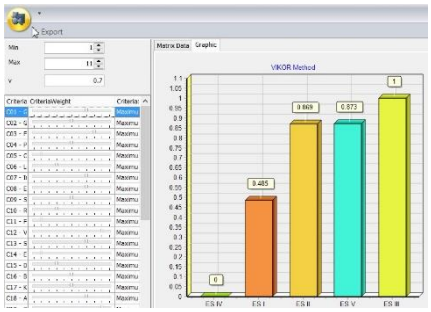

Fig. 8. The ranking before a coefficient change

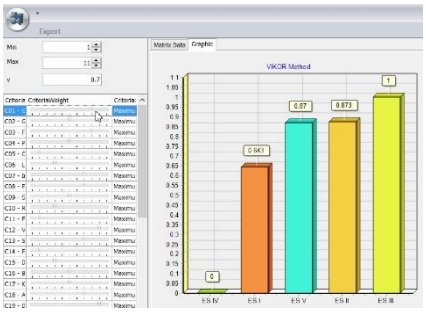

Fig. 9. The ranking after a coefficient change

All this shows that the new software system can be used successfully to solve the problem of multi-criteria ranking both in case of accurate assessments and in the absence of accurate and objective assessment of the compared alternatives.

5. Conclusion and future work

Nowadays the employees of different organizations and their leaders face the need for decisions on a daily basis (in granting a bank loan, in planning the financial activities of the company, in the selection of projects, etc.). In these circumstances, important are the accurate and clear tools for decision making in order to deliberately achieve the desired result.

The presented prototype of IEF for MCDA with AHP, ELECTRE, DEMATEL, TOPSIS and VIKOR methods, can successfully deal with such tasks through being able to handle both accurate and with fuzzy (fuzzy triangular) estimates. The conducted experiments proved that the rankings obtained with the new system are similar to those obtained by other authors. The existing differences are not significant and may be due to the specificity of input data and the near similarity in the assessments of four out of the five compared BIS.

The guidelines for future work on that topic are related to the implementation of various MCDA methods, built-in functionality to work with meta methods, with intuitionistic, hesitant, rough, ordered fuzzy, etc. sets experts' evaluations, libraries for converting assessments and weights from real into inaccurate numbers and vice versa, many experiments with various data etc.

Acknowledgement

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Solutions to a Balanced Approach between Strong Control and User Satisfaction in Business Mobility

Iskren Tairov, Veselin Popov

D. A. Tsenov Academy of Economics, Svishtov, Bulgaria
i.tairov@uni-svishtov.bg , v.popov@uni-svishtov.bg

Abstract. The paper reviews concepts of enterprise mobility and the benefits it brings to business. It focuses on developing a balanced approach in mobile devices control. BOYD concept is described and its alternatives. The COPE alternative with elements of other concepts is indicated as a rational way that ensures a balance between the convenience of using mobile devices and the security and reliability of business operations. Feasible approaches for its implementation are proposed. Benefits are outlined.

Keywords. Enterprise mobility, BYOD, CYOD, COBO, COPE, COLD, CLEO.

1. Introduction

Rapid growth of information technologies provides lots of opportunities that increase business efficiency. Information mobility is one of the latest trends in IT, which brings productivity and efficiency and needs serious attention of IT management. It is essential adequate strategies and policies to be created in order to achieve significant results in this area, as enterprise mobility is one of the fundamental technologies that offer diverse opportunities for business raising.

It is necessary for IT management to make a survey on concepts like BYOD (Bring Your Own Device), CYOD (Choose Your Own Device), COBO (Corporate Owned, Business Only) and etc., to ensure the successful implementation and followed control of mobile devices aimed at improving business efficiency.

2. Traditional approach – BYOD

The BYOD is associated with the use of consumer devices to perform business processes and tasks and subsequent integration of personal mobile devices that belong to employees in corporate infrastructure [6]. Overall this can include smartphones, tablets, laptops and home computers - owned by employees which are used to solve specific tasks, access to applications and databases.

Such solutions bring companies benefits like reducing costs, since the need of purchasing enterprise-dedicated devices for employees disappears. Also companies no longer have to offer the flexibility for employees to choose their own devices.

While providing clear advantages, BYOD poses serious challenges in terms of securing data which belong to the company and stored or displayed on the personal device of the employee. In particular, the fact that employees have full control on their devices, possibilities for developing effective solutions in providing secure access to sensitive and critical information by personal devices become rather limited.

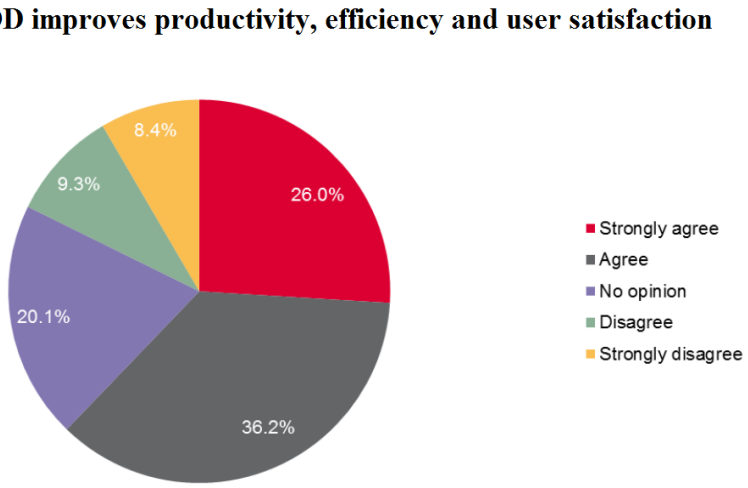

Fig. 1. Employees appreciate importance of BYOD concept [3].

3. Alternatives

Many companies have completely rejected BYOD and all similar approaches, with focusing on data security as primary concern.

The first alternative we examine is COLD, or Company Owned and Locked Down and it is described as the mirror image of BYOD [5]. This approach enables companies to restrict employees' abilities to make changes on their devices and this can ensure that employees are only able to load and use approved applications. This mitigates information security risks, but adds many restrictions to employees.

Another alternative is known as CLEO, which stands for "corporate liable, employee owned" [7]. According to this concept the employee owns the device but the employer pays for the usage and is responsible for managing and supporting the device. This approach can reduce costs (companies pay only for usage, which is much less than the cost of the device, also companies can negotiate for bulk rates on usage), and establish high level of information security.

Each user has a preference for devices and many prefer the device they have at home. Companies on the other hand can compile a list of approved devices which will meet the needs of the employee and the company. Thus was formed the CYOD (Choose Your Own Device) concept.

CYOD offers a culturally oriented approach to mobile business environment – devices can be preconfigured with all the necessary applications for employee productivity and protecting sensitive data that may be present on or accessible via mobile devices [9] [10].

Companies that choose the CYOD approach take responsibility for the selection and purchase of all devices. This in turn brings additional problems, mostly related to MDM – Mobile Devices Management [11]. MDM software can be installed and devices can be configured in advance, thereby the order process can be outlined, however, problems with the ownership of the devices still can be a serious challenge.

Lately a quite different approach of enterprise mobility has been discussed widely. It is called COBO (Corporate Owned, Business Only) [4] and highly defined as conservative. This

is due to the nature of the concept according to which the company owns the mobile devices and strictly prescribe how they are used by employees.

In developing a strategy and policy based on this concept, companies often resort to introducing a clause to ban smartphone, tablet or other device.

Limiting access to the vast variety of resources on the web social networks and broadband mobile access, in turn, proved the biggest drawback of the COBO approach – with the implementation of these restrictions employees opt for bringing on their own devices at workplace in order to combine work with personal communications by one device.

4. Creating the balanced approach: COPE + COLD + CLEO

Between the two extremes in enterprise mobility – strict COBO policy and anarchy in BYOD, appears a rational, balanced approach called COPE (Corporate Owned, Personally Enabled) [8]. This concept in its base model is in conflict with the BYOD ideology and its implementation is associated with serious problems for IT departments.

The ideology of this approach includes developing a centralized plan that provides selecting a device form defined list preconfigured, approved by the company devices, which the company owns and they are destined for business processes and they allow personal communications.

According to many experts, COPE concept combines the strict control of COBO and the freedom in using devices in BYOD [1] [2].

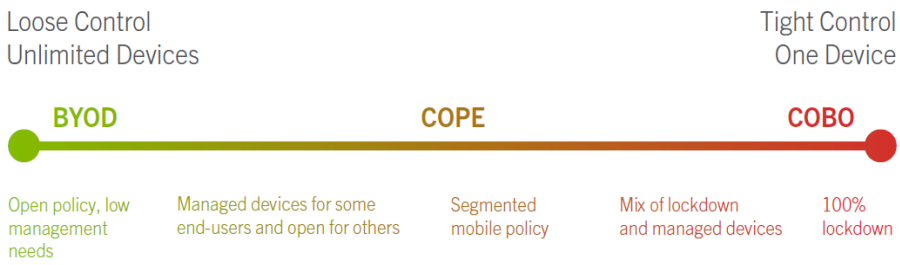

Fig. 2. COPE – the balanced approach [2]

In practical terms COPE concept allows a significant level of mobile management in the company to be imposed. This is associated with multiple risk profiles of devices and risky connections. The result is adequate control by a small number of operating systems, high productivity and mitigate information security risks without overloading the corporate network.

However, forming a balanced approach does not end with a COPE based policy implementation. A balanced and also effective approach should include:

- COPE policies:
  - Long-term BOYD concerns;
  - Work/life isolation;
  - New-found flexibility;
  - Additional benefits;
    - Cut down device chaos;
    - Reduce costs;
    - Tighten content control;

- Centralize oversight;
- Avoid litigation;

- COLD policy elements:
  - Shared devices
  - Standard configurations
  - Deploying local apps
  - Accessing business critical host apps
  - Restricting certain device\OS features
  - Security to protect against device loss
- CLEO practices.

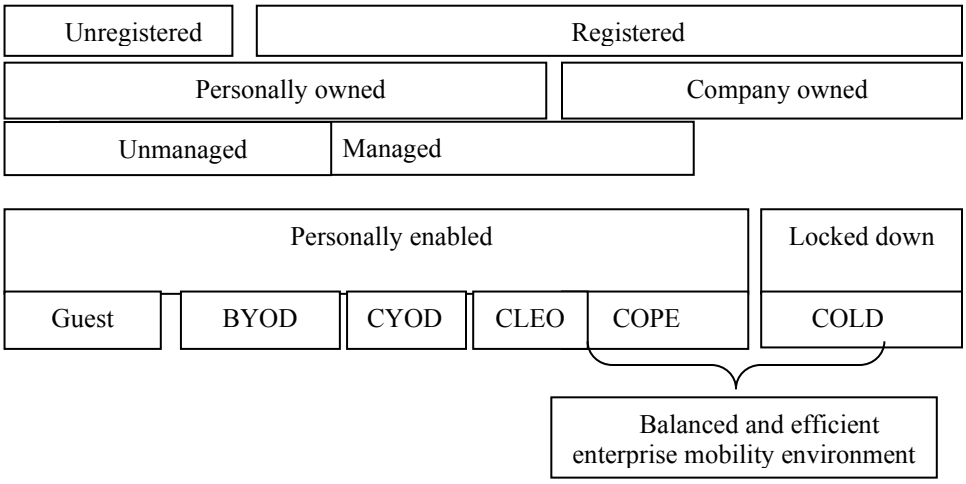

Fig. 3. Forming a balanced and affective approach in enterprise mobility

5. Trends in using own devices

In a survey, Gartner [12] outlines 10 mobile technologies that are important to the organisation and will provide potential for IT development in the business strategy of the organisation. These technologies can be classified into several groups:

- markup languages and technologies supporting the development of applications - HTML 5, advanced mobile UX design;
- devices and sensors: wearable devices, high-precision location sensing, mobile connected smart objects, which including LED light bulbs, toys, domestic appliances, sports equipment, medical devices;
- strategies, approaches and tools for mobile device management: enterprise mobility management – the future development of technologies for mobile device management, security and maintenance; metrics and monitoring tools - provide information about the habits of applications and diagnosis of interruptions;
- standards for mobile networks and communication protocols - new Wi-Fi standards (11ad, 11aq and 11ah), which increase the productivity and provide new services; LTE and LTE-A - cellular technologies increasing the speed of data transmission.

A study [13] conducted by Tech Pro Research on the use of Internet of Things, wearables, and BYOD concludes that 72% of the organisations claimed that they have allowed BYOD or plan to use it. Taking into account the forecast of Gartner that at the end of 2016 half of employees worldwide will want to use BYOD, the authors of the study suggest that BYOD will become more of a requirement than a privilege.

Research done by IDC [14] suggest that the percentage of USA employees who are mobile, will reach 72% of all working employees and BYOD will be accounted for the increase.

The discussed trends indicate that the use of BYOD and other types of mobile devices will increase. Parallel with this, tools for the development of applications for them, tools to manage these devices, communication technology and more will be developed.

6. Conclusion

The evolution of enterprise mobility and mobile device management reached such high levels that even strictly regulated industries are forced to allow employees to use company-approved devices for communications, business activities and entertainment such as access to social networks, games and etc. Benefits of using managing mobile devices and applications with the rapid pace of employees' mobilization and expected impact on the ability of the company to ensure the information security of data, located in a wide collection of mobile devices owned by employees, force management to have serious concern for additions and alternatives to the BYOD concept. Rapid development and acceptance of the concepts like COPE, CLEO and their mixture is due to its ability to combine the freedom of BYOD and conservatism of COBO model of enterprise mobility. The main advantage of the approach that includes elements of COPE, COLD and CLEO is that it solves the problem of implementing effective information security measures without restricting users or effectiveness.

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Use of Design Patterns for Developing Cloud Applications

Marya Armyanova

UE-VARNA, Varna, Bulgaria
armianova@ue-varna.bg

Abstract. Cloud computing allows use of computing power, storage space and data network, allowing access management. The use of cloud applications is becoming more popular, because of the savings that business realizes. The organizations have developed applications that sell all or part of their business activity. The problem with application moved to the cloud or to create a new application on the cloud platform is popular. The paper suggest an approach to create a cloud computing applications.

Keywords. Design Patterns, Cloud Computing, Approach, Genetic Algorithm.

1. Introduction

Cloud computing is a leading trend in the computer industry. They allow to reduce business costs by eliminating the need to purchase a software license for each employee who uses software; reduce the necessity of constant hardware upgrade; eliminate costs for rental of physical space for the server to store data or databases, etc. Cloud service providers offer use of computing power, storage space and data network, allowing access management. Such services offer companies like Amazon, Google, IBM, Yahoo, Microsoft, etc.

Based cloud computing applications require a high degree of automation of management of IT resources, for example to avoid any shortage of resources due to technical failures [1, 2]. Such automation is possible thanks to the provided by the suppliers of cloud services interface for management access of applications to resources without human intervention. Other features of the clouds as payment only for use and low resource requirements to individual customers also require management of the system in real time. One of these tasks is managing inflows. Can be realized with the aid of architectural patterns [1, 3].

This type of design patterns - architectural are used for development and management of applications based on cloud services. The main architectural design patterns enable the realization of the fundamental structure of cloud applications. Flexible design patterns determine how to adjust the size of the cloud application to the current workflow. [1] These concepts are fundamental to the usefulness and effectiveness of the application when leading principle of paying only for resources used. [4] This ensures efficiency of economies of scale, even in private clouds, as resources are allocated best among many applications running in the cloud if they are provided only for the period in which they are needed. Other architectural design patterns facilitate realization of access levels in cloud applications [5, 6]. They describe how cloud applications and their components are shared by multiple users.

The purpose of this report is to present an approach of using design patterns on cloud platforms.

2. Different ways of creating an application on the cloud platform

Developing a cloud application is implemented using approaches based on models. Proper design of applications for SaaS platform based on MDA (Model Driven Architecture)

[7] separates architecture of the application on two layers. The first layer describes the data, business processes and user interface. The second layer describes the model of the instruments responsible for implementation of the personalization of the application. By personalizing each user can receive service in a unique, suitable for him appearance. So the service can be changed according to customer requirements. Cloud SaaS platform and MDA presented the process of software development by focusing on the relationship between problem area and decision area and thus increase the manageability, performance and speed of the application. SOA decomposed application services. This allows reuse of software for different services, autonomy development and use, their abstraction, balancing their portability their discovery and linkage services. The authors Sharma and Sood [8] modeling system offers a higher level of abstraction to avoid dependence on the design pattern of application of the technology used. Their approach ignores the problems of personalization applications. Personalization is described by Jiang, Zhang and Liu [9]. The model-based adaptation is proposed by Inzinger and focuses on maintenance of the application by the provider of cloud services [10]. This approach uses information from the service provider to adapt the application according to its requirements. Moreover, the approach involves using information generated at runtime to determine the behavior of the application and to ensure effective management of the software. Management application includes securing the necessary infrastructure (resources), maintenance of the application and therefore its adaptation at runtime. Table 1 shows the comparison between the different approaches for development of cloud applications.

Table 1. Development approaches.

Approaches	Disadvantages
DSL (Domain Specific Language) [10]	The approach is dependent on a cloud platform and requires the use of a specific language for each cloud platform, where the application extends.
Approach of software reuse [8]	Make a compromise with the quality of the software, because some of the necessary application components may not be available in the cloud storage.
MDA for SaaS and EMAD (Enterprise Mashup Application Development) [12]	This approach does not provide customization of services, so it does not show how it is used by multiple users simultaneously.
Objectoriented approach [13]	Platform dependent approach consistent with a particular development environment.
MDA for SaaS [9]	Again ignore customization according to customer requirements.

The proposed approaches have some drawbacks - the process of development is consistent with the cloud platform; personalization of services not provided; It is not apparent how to provide services to multiple users; not represented sequence of work in the absence of several developed components for the application.

3. Approach of using design patterns on cloud platforms

The approach can combine the above approaches to overcome the disadvantages of each. The approach to the development of a cloudy application is based on the following sequence shown in Figure 1:

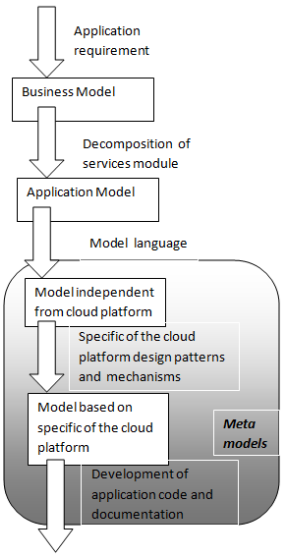

Fig. 1. Approach of using design patterns on cloud platforms.

The development of the application starts with creating a business model that is independent of the program realization. It describes only the business logic of the application. The developed business model corresponds to BpaaS layers of the architecture of the cloud. Experts IBM's model introduced BpaaS "Business Process as a Service" and separated by a fourth layer in the classification of cloud services and basic architecture of the NIST [14]. From a technological point of view, the activities of the business process as a service implemented by cloud services [11]. It is important to clarify that for this purpose use services of three lower layers of the architecture of cloud computing - software as a service (SaaS), Infrastructure of as a service (IaaS) and Platform as a Service (PaaS). In particular may be used SaaS applications to realize the goals of users, resources of implementation and management of applications PaaS, and infrastructure services for the implementation of applications and data storage. Therefore, some authors define "Business process as a service," not as a separate layer in the architecture of cloud services, but as a "wrapper" that integrates three main layers - IaaS, PaaS, SaaS.

To detail developed business model, first determine the basic services you need to realize the developed application. They correspond to the SaaS cloud layer of the architecture. On this basis, the application can be decomposed into separate modules and services to create a functionally complete model of the application. Then for each module that implements a service, is developed a model based on certain modeling language. It is generally recommended to be UML, since the documentation of most design patterns developed by it. If the models are developed by UML, it is much easier to make a comparison between the available design patterns and needs of the application, and to choose the most appropriate design patterns for a development. If one is not available, the corresponding functionality is designed through UML models. In this way is created application model, which is independent of the cloud platform. This is a metamodel that includes a variety of models for different services.

It needs the model to be tailored to the cloud environment in which the application runs. So by selecting the appropriate tools and specific design patterns that will be used in future development can fully use the functionality offered by the cloud provider. This latest model is

based on the specifics of a particular cloud platform. Once you develop a model independent of the cloud environment can be used automated tools for transformation and to generate a model based on the specifics of the cloud platform. Such tools have been developed for transformation of one model to another or to generate program code from the model. Such tools are based on definitions of transformation set of rules for transformation. During the transition from independent to certain of the environment model, each model module for service converts independently from others. So individual service is aimed at cloud environment that will work. This allows individual services to be performed in a different environment and finally to develop application running simultaneously with several suppliers of cloud services. Finally, different models are integrated into a complete model of the application based on cloud environment. After each transformation model of service should be monitored for its quality. To do this we need to measure quality of service and to check whether it meets the initial requirements. Can be developed a different number of models, if you use different tools. Finally we need to generate code for implementation accordingly the developed complete model of the application based on cloud environment. For example, converting the model into a platform of java, every class and model attribute corresponds to the class and attribute in the java platform. The type attribute is specified as java and private. Each operation of the class is implemented by the private member function of the class that returns a result consistent with the types in java.

The generation of the code becomes a semi-automatic, using the code of the selected appropriate design patterns that most closely match individual service models. Although part of the activities have development tools, it needs an developer active participation to realize a requirement specific to the design pattern code and integrate the various services generated by different design patterns in a comprehensive application. It may be necessary to develop a code of some of the services if there is not suitable design pattern for them.

Once the application is developed next phase is the deployment in the cloud. The provider of cloud services requires the necessary deployment of application data. These include models and so called bits of the application. Provider necessary models are a combination of application models. Application bits present behavior and the actual functionality of the various components. To be available to the provider these bits are presented as a package or URL, from where they can be downloaded. The model and the bits are combined in accordance with a package and bring in the cloud. Cloud platform analyze the package and develops a plan for distribution of application components between different servers. The aim is to achieve the necessary quality cloud service. In this developed plan must ensure dynamics of the service provided. So when increases the demand for a service provided by the application, to can be created new instances of the application. Similarly in reducing the demand for the service, these instances should be able to be deleted.

When the application is uploaded to the cloud and running, it is necessary to provide an interface so that remote clients to access these services. This interface provides web services [8]. Web service has several standard WSDL, UDDI, SOAP. WSDL describes the services that are available within the application and explains how to access these services. SOAP specified by the communication protocol, the message format for exchanging information between services. UDDI registry supports different types of services that localize them. Each user has a unique ID through which can access the service. Consumers use a different set of options in the work environment. This stems from the need for personalization of service [7] and is achieved by modifying the models. The package of the application consists of the design patterns, files with the description of the model and tools of the model. The design patterns of the model are real models, but represented by a specific standard. Files with the description of the model are files received after customizing or modifying the design patterns of the model.

They are specific to each user and stored in a separate directory intended for this user. So each user can use the services independently of the others. Model instruments assist in customization of design patterns files and create files with the model description.

A key feature of cloud applications is scalability. When demand for services exceeds the service threshold, can be created new instances of the service. These instances must be deleted when demand drops below a certain level. To automate the creation and deletion of instances is necessary to include appropriate indicators in the model specifying when to create and destroy an instance. Furthermore, the model can add information showing how to adapt the application in the cloud environment [8]. Different service providers require their applications to behave differently. Some require their application is always available, others - their application to have a little reaction time even at peak times, and some prefer the lower costs for the use of cloud environment. This information helps the provider of cloud services to provide management tailored to application requirements. Cloud providers predict applications work and resource allocation dynamics, so to can manage the work of various applications. For the purpose used data of similar applications work.

Application allows to be transferred to different cloud platforms, by developing a model that is independent of the cloud platform. It should also describes ways of services personalization, so that the application can handle wide variety of customers. Customers of can personalize it the service, by their requirements. So the data for each customer are stored in a separate directory associated with their identifiers. They have access to independent of other service and one software instance can serve multiple clients. The approach to development complies with various cloud architecture issues and provides a framework for better cloud software development.

The creation of models of independent cloud platform provides software portability and adaptability to environment changes. One such model may be transformed into a number of different models tailored to cloud platforms. This avoids the need for redesigning the application for different platforms and extended life cycle. The application is described by models and transformations between them, ensuring their better perception of stakeholders. The decomposition of services SOA, allowing services to be developed relatively independently. So more easily detected a suitable design patterns that implements the service. Developed modules for services can be reused as design patterns in improving the application or in other applications. The storage of customer data in a separate directory allows customization of services and ensures a level of security and confidentiality of customer data. The use of design patterns reduces the need for testing and software documenting, so that reduces development costs and ensures a certain level of application quality. The approach also has drawbacks, such as the large number of created models are difficult for management. The models are not ready application, therefore they must be converted into code before being executed. This leads to additional costs.

4. Conclusion

The report shows some shortcomings of the approaches used to develop cloud applications and on that basis present approach involves the use of design patterns.

Each design patterns describes some aspects of the consumer group, the cloud environment at work or cloud applications. This helps users to find the appropriate design patterns for the needs of the developed or refined cloud application.

The proposed approach shows the sequence of development of different models of cloud application, providing creation of complete documentation of the application and implementation of the application requirements. The use of design patterns reduces the cost, time and difficulty in application development. The resulting applications have a guaranteed

level of quality, long life, flexible, portable and can be dynamically scaled and customized according to user needs.

Therefore the described approach is a promising area for future research.

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Software Weaknesses Formalization

Vladimir Dimitrov

Faculty of Mathematics and Informatics, University of Sofia, Sofia, Bulgaria
cht@fmi.uni-sofia.bg

Abstract. Software weaknesses are primary types of security issues. Semantic templates and Software fault patterns are tools used for software weaknesses description. Software weaknesses are described in formatted text. There is no widely accepted formal notation for that purpose. This paper shows how UML can be used for formal specification of weaknesses on the example of CWE-119.

Keywords. Software weaknesses, Formal specification, UML.

1. Introduction

In [1], the term "software bug" applies to the following concepts:

- **Weakness** (Common Weakness Enumeration - CWE): A type of mistake in software that, in proper conditions, could contribute to the introduction of vulnerabilities within that soft-ware. This term applies to mistakes regardless of whether they occur in implementation, design, or other phases of the SDLC. [2]
- **Vulnerability** (Common Vulnerabilities and Exposures - CVE): An occurrence of a weakness (or multiple weaknesses) within software, in which the weakness can be used by a party to cause the software to modify or access unintended data, interrupt proper execution, or perform incorrect actions that were not specifically granted to the party who uses the weakness. [3]
- **Attack** (Common Attack Pattern Enumeration and Classification - CAPEC): A well-defined set of actions that, if successful, would result in either damage to an asset, or undesirable operation. [4]

An attacker has to find and exploit a weakness, exposed by a weakness, and realize the vulnerability.

These are important concepts that are related but different. A weakness is a static presence existing in software systems -- it might stay in software and never cause any problems until it is exploited by an attacker, and when the attacker finds out the weakness (es) and exploit it (them), the vulnerability of this software is exposed.

2. Deeper

The following questions can provoke further thinking and discussions throughout the Software Assurance community and beyond:

- What formal methods can be used to help formalize CWEs with required accuracy and precision and at the same time allow for further extensions?
- To what granularity should CWEs be formalized? Finer granularity means more flexibility (especially when new weaknesses are identified, the extracted commonalities can reduce the re-invent work) but more effort to create them; coarser granularity indicates the easy-to-use weakness items while we need to re-invent the wheel every time.

- How can the formalized CWEs be used and in which domains? For education and training? To prevent vulnerabilities? To integrate into software IDEs, test tools, and tools that generate test tools?
- How can an automatic system be constructed to record newly identified vulnerabilities and classify them by CWEs? With better formalization and finer granularity of CWE definitions (which also means limited dictionary for weaknesses, better taxonomy of vulnerabilities), text mining could be the potential technique to mapping CVEs to CWEs at least semi-automatically.

In response to the above query is the focus of this research. The main fact is that the vulnerability is a realization of a weakness of the software. This gives is in the following two aspects:

1. A realization of a vulnerability happens through and attack or attacks, i.e. there is the dynamic aspect.
2. The exploited weakness itself is a property of the software, i.e. this is the static aspect.

The description of the dynamics of the attack can be done with Communicating sequential processes (CSP) [6], while the property of the software (static) can be described with Z notation [7]. An alternative is to use UML [8] class and object diagrams for the static properties of the weaknesses and activity diagrams for dynamic ones. The paper is focused on the last approach.

Following the Semantic Templates idea [5] is explored in details. The idea there is to build a data base with knowledge about the vulnerabilities using the available repositories. In other words, first the repositories are annotated according the software template. Then, in each part of the template, semantic nets are organized with 3 kinds of arrows. The main idea in [5] is that one vulnerability can be represented by several weaknesses in each component of the template. However, the problems are much more. For example, the leading idea is that Semantic Templates can be extracted automatically or semi-automatically from their natural language descriptions, but how clear and descriptive are these descriptions is an open question to do that. There are available instruments, but we doubt this is the proper direction to follow.

The first task is: Describe vulnerabilities as chains of weaknesses. What Yan does is connecting a given vulnerability with a concrete (root) weakness and from there develops the template. This means that she misses the attack. While indeed, the attack is performed following a scheme, it is dynamic and rather the vulnerability is a successfully conducted attack, and not a property of the software. The latter is a weakness of the software.

The vulnerabilities have to be described as attacks and not as chains of weaknesses.

If it is needed to describe the relationships between the weaknesses, as it is in Yan's dissertation, it is better to use the UML notation. Diagrams are preferred nowadays. Even, using UML to define a diagram that reflects the relationships between the weaknesses. The dynamics of the vulnerabilities can also be presented with diagrams.

Anyway, in UML the software is described with the three models of classes, states, and interactions. The static aspect of the relationships between the weaknesses can be presented with a class diagram or a specialized such. The dynamics in time of a separate weakness can be presented with a state diagram. The attacks and the connections between the weaknesses can be described with activity diagrams and other kinds of diagrams from the interactions model. Note that there are no good tools for re-engineering but there is work done in this direction.

3. Formal Specification of CWEs with UML Class Diagrams

The easiest and most attractive way is to create a class diagram, in which the weaknesses are classes and the relationships between them are presented as associations.

Figure 1 represents Yan's strategy in [5].

The mental model is useful for reading the database contents. It is also useful to follow the links among CWEs. However, it is impossible to generate from the mental model test or verification code. Semantic Templates are at knowledge base level and do not impose further pragmatic exploration of its descriptions.

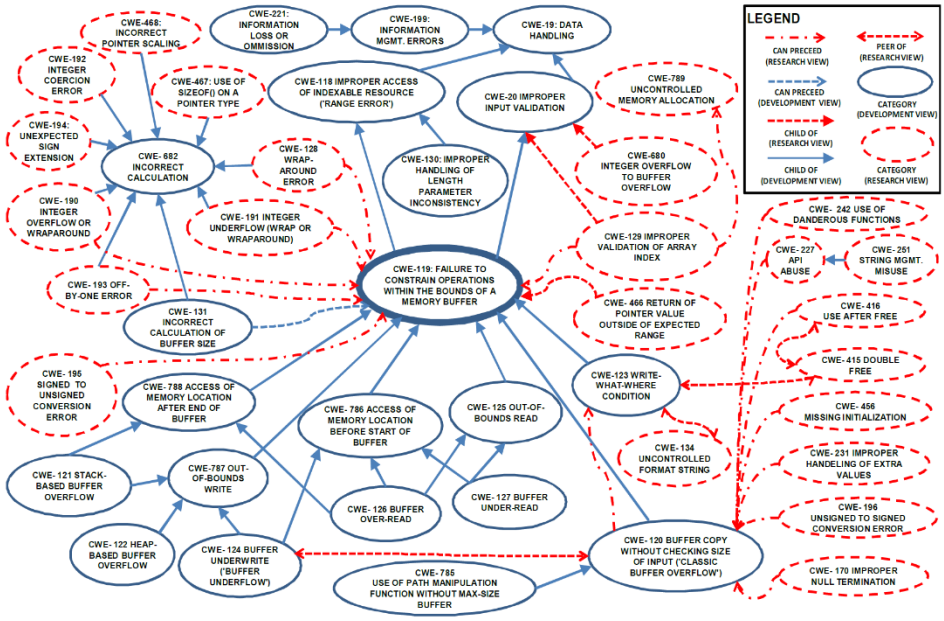

Fig. 1. Buffer Overflow-related CWEs Extracted in the Preparation and Collection Phase from [4].

So, the following three diagrams (Figure 2 - 4) are extracted from Figure 1. The idea is to separate "the mental model" of the original diagram into two views: a research view and a development view. The research view is presented in Figure 2 as one diagram showing both the inheritance and the precedence relationships.

The development view is further separated into 2 diagrams: an inheritance diagram (Figure 3) and a precedence diagram (Figure 4). This way the model is more readable, but more elaboration is needed to make sure these kinds of views are best.

The three diagrams are UML class diagrams; created with IBM Rational Software Architect (RSA) [9]. However, they can be transformed into specialized diagrams – UML & OCL, RSA allows creation of specialized metamodels for new diagram types.

Note that Figure 1 from Yan's dissertation is extracted from CWE, but this is not a trivial task. That is why Yan's work has been used as starting point. The complete mental model for CWE-119 could be created by retrieving data directly the XML, extracted from the CWE database. Figure 5 presents the current, still not complete diagram of the CWE-119 Relationships mental model.

The mental model follows by hand the links given in CWEs database. Every CWE accessible via some path of links starting from CWE-119 must be presented in the diagram. Big problem is how to position the different CWEs with different roles on the diagram in some clear and readable way, but the hope is that suitable recommendations would be developed for that.

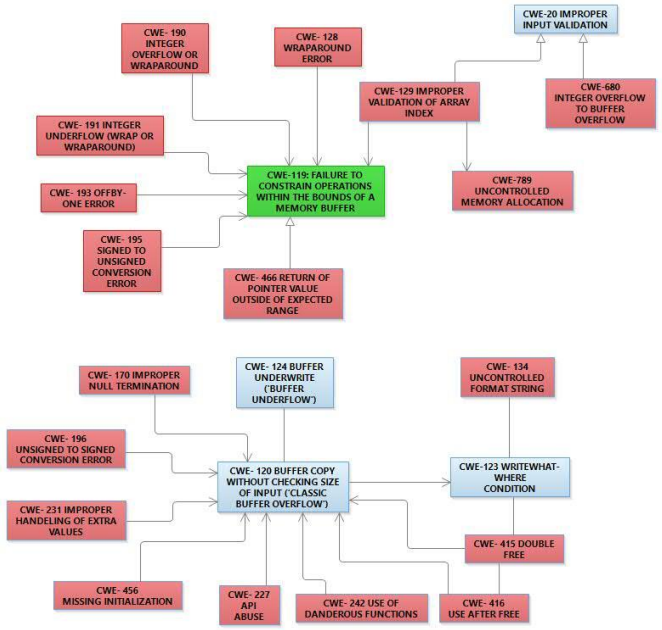

Fig. 2. CWE-119 Research View.

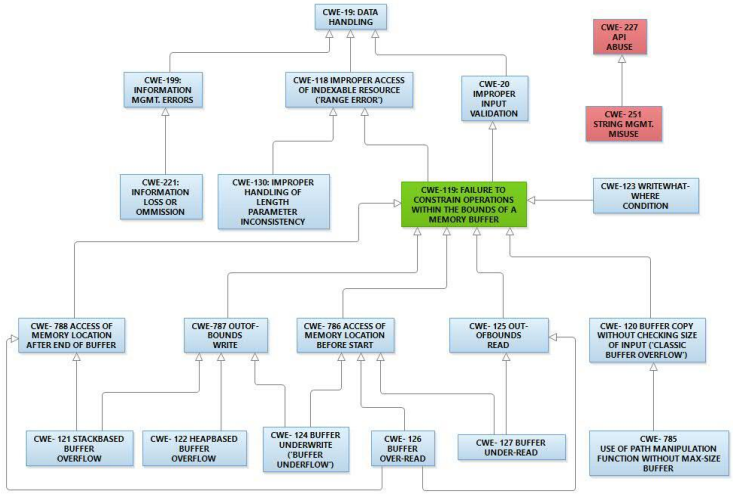

Fig. 3. CWE-119 Development View with Inheritance.

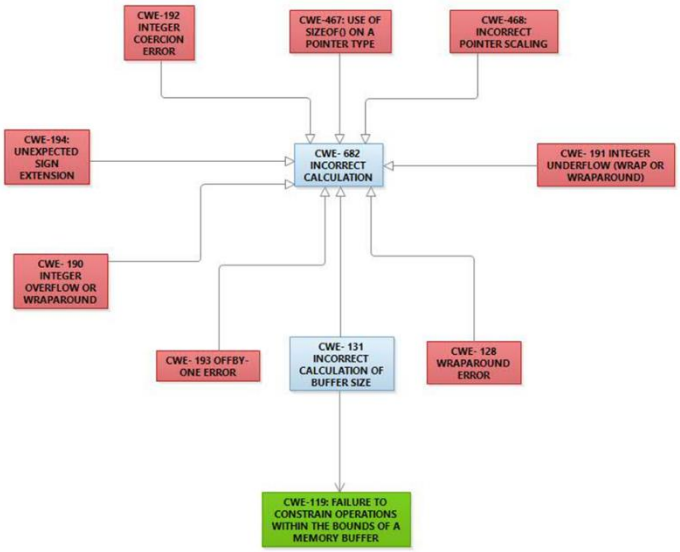

Fig. 4. CWE-119 Development View with Precedence.

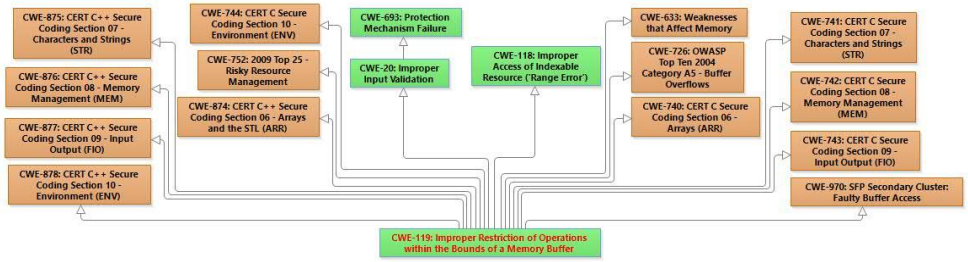

Fig. 5. CWE-119 Relationships - not complete yet.

4. Conclusion

One big problem for representation of CWEs in UML diagrams is the need for automatization. The CWEs are represented in XML database, but some information is in text format. The purpose of Semantic templates is to extract formatted and unformatted information from the database.

CWEs representation in UML diagrams is good for better visual acceptance by humans. UML is well known notation in the community. There are many tools that support UML. Even more, specialized profiles for CWEs could be developed in UML.

It is convenient to generate code from UML in many tools. Such generators could be developed in the UML tools to generate test and verification sequences for CWEs.

In this paper possibilities for representation of CWEs in UML diagrams have been discussed. UML is a notation for software specification. It is formalized with metaclasses by OMG. UML permits the software to be specified at the appropriate level of details in any case. If it is needed OCL can be used for further accuracy.

CWEs are organized in abstraction several levels. UML permits such a taxonomy organization with class and object diagrams. The class diagrams organize abstraction levels and the object diagrams stay on the base.

UML diagrams could be used for training, education and software development. Their notation is primary developed to humans. UML diagrams can be used as a source for generation of test sequences, verification code etc. that support the software development, testing and verification. Tools that support UML, like RSA, are usually open for that purpose.

Tools for semiautomatic identification of vulnerabilities and their classification to the CWEs could be implemented in object-oriented classification style using the artificial intelligence for text recognition and understanding. The work in that direction is huge and many research must be done but Semantic Templates are good starting point.

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Stratagematic Approach to Service Design in Higher Education: Building an Ecosystem Frame to Deliver on Excellence in the Service Experience

Vanya Slantcheva-Baneva

MT&M College, Sofia, Bulgaria
v.slantcheva@mtmcollege.bg

Abstract. The paper reviews some considerations of applying business ecosystem concept into the higher education's service delivery. It gives insights about how policymakers can transform the higher educational institutions (HEIs) in Bulgaria from service- to student-oriented one, and how they can improve their performance in terms of Customer/Student Perceived Value assessments. Thus, a business model canvas of an HEI is developed to reveal both "whole the picture" of the service experience and interdependence between the ecosystem design and the service value proposition to prospected student targets. Additional conceptual model is represented to track that interdependence from the perspective of perceived service quality.

Keywords: Ecosystem strategy, Service design, Business model canvas, CPV, HEI.

1. Introduction

Higher educational institutions (HEIs) in Bulgaria live in a dynamic and an uncertain context. The educational market is in a saturated phase, when generating new demand causes frustration to HEIs because of the external factors they face: competition of an intensive market structure, decline in population growth rate, preferences for education abroad, and emigration of young people. But still the market *itself* encounters demand for higher education. And it is more likely that the market strategies that HEIs are to undertake should be towards market development or diversification, rather than market penetration. It becomes critical for them to innovate, and to do it by creating value basically though their business model alternations. Prescriptively, they should match their innovation strategies with adjustments in their ecosystem architectures as an important element of the cost structure in their business models. Moreover, it will stratagematically resound in novelties in educational service experience.

The purpose of this report is to review the interrelation between setting-up and improving a HEI's ecosystem, and designing its value proposition as an adjusted educational service delivery to prospected and served targets of students. From HEI's perspective it is about revising interdependence between the input and output of the educational service production, or between the HEI's internal and external efficiency. Qualitatively, from student perspective, that interrelation is regarded as student satisfaction measurement of how they perceive the service quality and evaluate the service process.

2. Business ecosystem pattern

The definition of an ecosystem extends the well-known biology concept to define the system of mutually supportive parts – in our case: organizations, teams and individuals – including customers, suppliers, investors, regulators, and other stakeholders—that interact in

an adaptive and self-sustaining manner to accomplish shared goals [1]. Ecosystem is a collaborative arrangement through which organizations combine their individual offerings into a coherent, customer-facing solution under competitive ecosystem strategy.

Business ecosystem then is defined as the network of partners, supporters, customers, and other stakeholders that work together either to launch a venture, or to grow an established business organization. And ecosystem strategy could be deployed into variety of industries and branches, such as in the higher education. Designing an ecosystem requires founders and founding teams to build long-term partnerships. Many need such relationships to enter a market or industry; others seek access to short-term resources and connections that will help them grow their businesses; still others are launching innovations that require complementary innovations from players in multiple industries. While a business organization can take a structured approach to establishing an ecosystem, it is important to note that the network of connections often emerges organically, as new relationships develop through chance events and encounters as well as through introductions by new ecosystem participants [2, 3].

Important part of an ecosystem is the customers, because their feedback and support are critical in developing and refining the organization's offering and value proposition. Crafting the value proposition for key stakeholders of a business organization involves identifying the benefits that will be created and how those benefits will enable the organization to attract and retain the stakeholders. It is helpful to begin by returning to the choices the founders make as they 1) define a unique strategy and 2) identify the resources and capabilities required to execute the ecosystem strategy. These choices help them identify key internal stakeholders – founding team members, key employees and advisers, and key external stakeholders (customers, suppliers, partners, and investors /shareholders). After identifying these stakeholder groups, business organizations assess their interests and expectations, also the value that each group will provide, and the value each will require in return for helping to achieve mapped key milestones. In defining stakeholder value organization's management is to think about tangible and intangible benefits.

As they assemble the capabilities and the resource requirements, business organizations have been building the ecosystem. Ecosystems have always existed, but they were traditionally called *value chains* to reflect the linear sequence of value-creating activities involved in designing and producing a product or service, and then marketing, selling, and delivering it to revenue-generating customers. By expanding and adapting ecosystems, general management can experiment with and refine organization's business models.

3. Unfolding Business Ecosystem Pattern within Higher educational organizations

The linear sequence of value-creating activities typically involved in designing and producing a physical product, and then marketing, selling, and delivering it to revenue-generating customers or end users will be considered here by means of value-creating activities particularly in service organizations. That requires specifying services nature as a ground for building ecosystems.

Services are defined as processes and series of intangible activities that take place in interactions between the customers and service employees and/or physical goods and systems of the service organization, which are provided as solutions to the customer problems [5]. That rationale identifies three basic characteristics of services: 1) services are processes consisting of activities or a series of activities rather than of things; 2) services are simultaneously produced and consumed, and 3) the customer participates in the service production process. Moreover, it is critical to realize that the service consumption is a process consumption rather

an outcome one. It means that the customer perceives the service production process as part of the service consumption, but not the outcome of that process, as it is well-known by the traditional marketing paradigm of physical goods. Because of that inseparability of the process and the consumption of the service, the service production process is delineated as an *open process* and the consumption – as *process consumption*. Then service encounter or customers' interactions with the service production process ("servuction") [5, 6] become part of their consumption process.

Here, taking into consideration the service provision and production patterns, the interpretations above are reposed into the service production-consumption process at a higher educational institution (HEI).

Coined by Pierre Eiglier and Eric Langeard, the term "servuction", combining the terms service and production, describes the service operations system as that part of the service provider's physical environment and goods, which is visible and *open* for processing to customers, contact personnel, and the customer in person. Christopher Levelock expanded that conceptual framework and embraced three overlapping elements [6]: *service operations* where inputs are processed and the elements of the service product are created (in our case they include enrollment, service purchasing, courses' selection in student-administration interaction); *service delivery*, which embraced process consumption and where final "assembly" of those elements take place and the product is delivered to the customer (by means of teaching, exanimating, grading processes in student-lecturer encounter); and *other contact points*, i.e. all points of contact with customers, including advertising, billing, and market research.

Hence, the linear sequence of the value-creating activities at the HEI would be non-typically involved in a) designing, marketing and selling *in advance* the educational service to revenue-generating customers – both to existing and prospected students, and b) *then* producing and delivering it to them.

Table 1 envisions the identification of the core activities needed to design, produce and deliver the higher educational service to students as end users.

Table 1. Value chain determination of a typical HEI.

HEI INFRASTRUCTURE *(FROM MASS-MARKET TO SEGMENTED-MARKET STRATEGY)*					
HUMAN RESOURCE MANAGEMENT					
TECHNOLOGY DEVELOPMENT					
PROCUREMENT					
MARKETING AND SELLING	INBOUND LOGISTICS *Student enrollment and hunting Building service expectations*	HIGHER EDUCATIONAL SERVICE PRODUCTION AND DELIVERY *Teaching and Examination Administration process*	OUTBOUND LOGISTICS *managing alumni*	ONGOING MARKETING	SERVICE *administrating and additional educational services*

These core activities are focused in the prevailing part of *operations* activities as HEI's service production and delivery. *Inbound* and *outbound logistics* transform the student (the customer) respectively from hunting prospects to managing alumni. Apart from marrying service open production process with its consumption process, marketing activities of the HEI are *contextually* stepping before the core operation activities have being executed. Or,

"marketing and selling" higher educational service is about managing prospects so that they should pre-pay the service production and delivery processes, rather than selling a service production outcome to them.

Once the core activities are identified, using the Value-Chain Analysis, the HEI ecosystem's design continues with defining activities that HEI performs and those to be performed by partners. In other words, drawing HEI ecosystem means to identify key partners (e.g., suppliers, channel parties, logistics players, partners, and other stakeholders) and to design the relationships among them, including the flow of product and services, information, and money.

By representing a business model canvas of a higher educational service delivery [Table 2], the HEI ecosystem is unfolded as the "left" part of the canvas when the cost side of the model is determined as an interplay of organization's activities-resources-partners. To pursue revenue-generating streams, HEI's *value proposition* to student segments is to be assured by conducting *key activities*, such as: teaching (advising, examining, grading students; course designing, content development), exchange and mobility, R&D, publishing, cooperation with business, staff training (facilitating, career enhancement, administrating, student and staff affairs, IT, additional services), maintenance and repair. These HEI's activities are to be provided by acquiring *key resources*, such as: human (teaching staff), tangible (brick & mortar building or campus), intellectual (high brand awareness and image), and financial (state, project or corporative financing)

Table 2. Business model canvas of a higher education's service delivery

<table>
<tr>
<th>KEY PARTNERS</th>
<th>KEY ACTIVITIES</th>
<th>VALUE PROPOSITION</th>
<th>CUSTOMER RELATIONSHIPS</th>
<th>STUDENT SEGMENTS</th>
</tr>
<tr>
<td rowspan="2">• Providing capacity-building solutions and extending image and global reach – universities, institutes, educational centers,
• Acquisition of academic activities, training and consulting organizations, NGOs
• Reduction of uncertainty – High schools, First-cycle degree institutions</td>
<td>• Teaching (advising, examining, grading students; course designing content development
• Exchange and mobility
• R&D
• Publishing
• Cooperation with business
• Staff training (Facilitating, Career enhancement, Administrating, Student and staff affairs, IT, Additional services)
• Maintenance and repair</td>
<td rowspan="2">1. Progressive and proactive higher educational service co-created with the student

2. Highly performed bundle of educational programmes within a modern physical environment

3. Practitioner-centered educational service with up-to-date course design

4. Better-infrastructured and better-attributed educational</td>
<td>• Personal academic or mentor assistance
• Automated administrative services
• Extra-educational self-service (library, Café, IT services, bank services, gym)
• Communities and alumni
• Co-creation initiatives (logo idea generation)</td>
<td rowspan="2">1. ALERT HIGH-SCHOOL GRADUATE

2. SCHOOL-LEAVER & COLLEGE SEEKER

3. "GO-TO-WORK" STUDENT

4. SWITCHER FROM OTHER HEI</td>
</tr>
<tr>
<td>KEY RESOURCES
• Teaching staff (academics,</td>
<td>CHANNELS
• "Brick & Mortar" education: HEI</td>
</tr>
</table>

	practitioners, Non-teaching staff, • B&M store (learning areas and facilities, classrooms, equipment, IT system and infrastructure, • Brand (copyrights) • Financing (state, project or corporate)	service and awareness	building, University campus, Subsidiaries • "Click & Mortar" education: Distant or e-learning Platforms	
COST STRUCTURE Value Driven (focused on value creation) High fixed costs structure (salaries, rents, utilities) Variable costs – part-time lecturer wages Economies of scale – reducing the average cost per programme Economies of scope - reducing the average cost per course Per Student Economics			**REVENUE STREAMS** **fixed pricing** • Student Fees (Term fee, Usage fees, Subscription fees, Administrative services fees, Licensing) • Part-time teaching staff fees • Publishing • Social-life activities fees **dynamic pricing (**Negotiation)	

Consequently, the *key partners'* ecosystem is to be built on pursuing the common aim at: 1) providing capacity-building solutions and extending image and global reach of partner universities, institutes, educational centers, 2) acquisition of academic activities, training and consulting organizations, NGOs, and 3) reduction of uncertainty by horizontal integration with High schools, First-cycle degree institutions, Student-hunting mediators.

4. Designing Business Ecosystem by means of Student Perceived Value

Becoming keenly aware within the higher educational context, Marketing has been envisioned by the policymakers as both an *open* activity to target and enroll students segments at the entrance of the HEI, simultaneously to build their service expectations, as well as an *ongoing* activity to monitor student satisfaction for better understanding their needs and to make respective changes in the service proposition. In Bulgaria where most university education is based on state universities, policymakers have started to consider higher education as *a service* delivered to students. As a result, most Bulgarian HEIs have begun to gather satisfaction data from students in order to update and adapt their own educational offerings and to become more attractive to them.

The consideration of *student satisfaction* is derived from the customer satisfaction concept. Customer satisfaction of a service is basically the customer evaluation of its features and attributes and is an assessment of the perception whether it has met their needs and expectations. What can affect customer perceptions of satisfaction are the customer emotions induced by the consumption experience with the service delivery and the attributions for a service success or failure [8].

Respectively, the student satisfaction with the higher educational service can be concerned by the possible gaps between the student's consumption experiences (service

perception) and student's service expectations. Applying the emotional issues to students' satisfaction defines their satisfaction as perceptions of or attitudes towards learning activities and teaching staff. Than student satisfaction is seen as a key marketing outcome of their education and as a quality-enhancement tool designed to improve the quality of the students experience and value perception with the service [4].

Monitoring student satisfaction requires that HEIs continuously collect data and information on what students think about the educational service delivery. That marketing activity (and ability) of HEIs is considered as an index of their own attentiveness to student requirements and as a measure of efficacy and success. It is important to note that a limitation of the student-satisfaction-approach to course design is that it does not involve any measure of a program or a course effective quality in terms of students' learning and teaching quality. Regardless the educational service quality and student satisfaction are distinct concepts, they are related by the concept of Customer Perceived Value.

CPV is the difference between the prospective customer's evaluation of all the benefits and costs of an offering and the perceived alternatives. Then we could accept that Student Perceived Value is the anticipated benefit from student's perspective of the higher educational service, and stems from the tangible and intangible advantages for him/her [Fig. 1]. Or, the student approaches the service as a prospected value proposition for his/her higher education from which he/she could benefit better service quality at a given price (costs) for accessing the service. From one side, costs for the student is a financial reflection of the internal HEI efficiency, and from other side, the evaluation of the *Student Perceived Quality* is an index, which HEIs use to measure the service output or their external service efficiency.

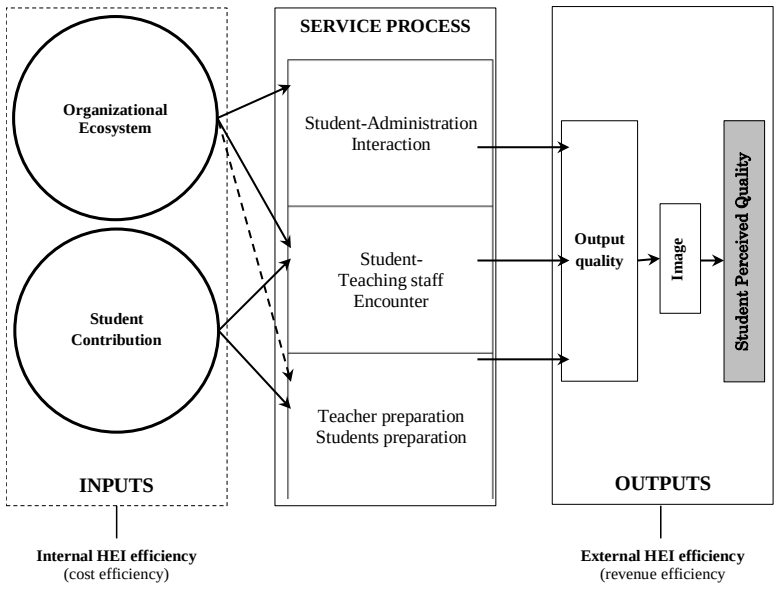

Fig. 1. HEI's internal and external efficiency model. Adapted by: Grönroos, 2000: 214.

As we mentioned above, HEI's ecosystem design involves identification of the core activities. Allocating the key resources and building up the web of partners, whom to perform some of those activities needs to be measured by the revenue-generation customers, i.e. the students. Then, highlighting the ecosystem's players that have tremendous power – because of

proprietary assets or scarce resources they control, unique capabilities they have, product or services they provide, or value they have created – is a premise to define and correlate the service quality and the cost of performing HE activities and the cost of providing the service internally and externally. Or such a comparison needs to be conducted in terms of balancing ecosystem development and Student Perceived Quality measurement.

5. Conclusion

The paper reasonably shows that setting-up business ecosystem strategy at HEIs primarily reflects designing the HEI's service value proposition and evolving it by continuously monitoring the service experience using Student Perceived Quality metric. More or less, it requires student-cantered management based on the HEI's relationships with the student as a subject of the service itself. In addition, evaluating the Student Perceived Value helps policymakers to begin critical shift from a service- to a student-centered HE organizations. It can help HEIs to adjust their internal efficiency as they can run their key activities in external partnerships to stratagematically (trimly) manage the costs of service experience, considered as its production, delivery and consumption, where the student is an active participant.

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Computer Based Straight Linear Filtering the Pressure Signal of Electric Sphygmomanometer with Recurrent Algorithms

Lubomir Lahtchev

Institute of Systems Engineer and Robotics - BAS, Sofia, Bulgaria
lahchev@iser.bas.bg

Abstract. The level of confidence into a signal satisfies, when the graphics of its progress development is smooth and settled free from noise and disturbances. The science achieved advance at filtering and cleaning the signals within wide spectrum physical phenomena, presented by graphics of electric processes. The picture of pressure signal, feed from electric sphygmomanometer of Hartmann to the desktop computer, represents piece wise line sequence, fulfilled by drop pulsations during long straight linear domains at comparatively smooth declivity line segments of transition ranges. An author new filtration method and recurrent algorithm by line segment end points is applied on filtering the piece wise line pressure signal for tension sensor of electric sphygmomanometer. Its signal process line is smooth and adequate to the original signal process. It is supported by a regular recurrent algorithm and graphics of the same process with account the known developments in this area. The assessment by coefficient of filtration is also completed.

Key words: Filtration, Sphygmomanometer, Pressure signal, Computer.

1. Introduction

The term "Filtration" in the science reflects different contextual reasons. In the early scientific monographs with a representative [1] Liptser and Shiryaev solve fundamental tasks in the terms of statistics the occasional processes. "Important domain of tasks the statistics of occasional processes is formulated within the frame of the next scheme.

Within the randomly probability area **(Ω, F, P)** a partially observed probability process is given $(\Theta, \zeta) = (\Theta_t, \zeta_t)$ at $t \geq 0$, to whom the second component only can be observed $\zeta = (\zeta_t)$, $t \geq 0$. At each one time moment **t** it is required with fundament on observations $\zeta_0^t = \{\zeta_s, 0 \leq s \leq t\}$ the assessments of non-observed values Θ_t to be given. This task of assessment (else – task of filtration) of Θ_t by ζ_s^t will be studied in the current monograph." This formulation of the filtration task represents task of assessment the non-observed values of component Θ_t in a probability process, for which observed values of ζ_0^t are known. The computational criteria are formulated as follows. "Since computation point of view the formula determining the "filter" m_t, $t \geq 0$ has to be of a recurrent character. Commonly told, that means the value $m_{t+\Delta}$, $\Delta \geq 0$ must be restored by the value of m_t, and observations $\zeta_t^{t+\Delta} = \{\zeta_s, t \leq s \leq t+\Delta\}$. In a case of discrete time t=0, 1, 2, 3, … the simplest form of such a recurrent ratio can serve equation:

$$\Delta m_t = a(t, m_t) + b(t, m_t).(\zeta_{t+1} - \zeta_t) \quad (1)$$

where $\Delta m_t = m_{t+1} - m_t$. In the case of continuous time stochastic equations possess such a form:

$$dm_t = a(t, m_t).dt + b(t, m_t).d\zeta_t \quad (2)$$

Obviously, it will be difficult to rely on the circumstance that optimal assessments $\mathbf{m_t}$ will satisfy the recurrent ratios 1 and 2 without special suppositions about structure of the processes **(Θ, ζ)**."

Hence, the principle of recurrence here defines the every one next value $\mathbf{m_{t+\Delta}}$ to be restored from $\mathbf{m_t}$ or respectively non-observable $\mathbf{\Theta_t}$ – from observable ζ_0^t. With account the "special suppositions" the development of solutions about those tasks would based on real examples, which in the monograph [1] are presented with increasing complexity. Resuming, the first main supposition consists of the phrase: "…partially observable occasion process **(Θ, ζ) = (Θt, ζt)** at **t≥0** is a Gaussian, and is controllable by stochastic equations".

The second one supposition is "Considered task of filtration consists of the circumstance that at each one moment of time **t≥0** it is optimal (inside the mean square reason) to assess $\mathbf{\Theta_t}$ – along with ζ_0^t ".

With account the exposed ideas of the filtration task in the context of mathematic reason, the brief interpretation formulation [2] about an electric filter is accepted here. The filter is "… a device or program, which separate data, signals, materials on the base of defined criterion." On the other encyclopedic side, the electric filter is "…a device for separation the electric waves of different frequencies". Hence, the task of filtration the pressure signal of the electric sphygmomanometer, restored in a desktop computer, consists of definition the slowly changeable pressure component without drop vibrations of higher frequencies. It is supposed the drop vibrations create noise background surrounding the mean value of pressure within the ranges of smooth variation. General view about the graphics of such a filtration is seen on fig. 1.

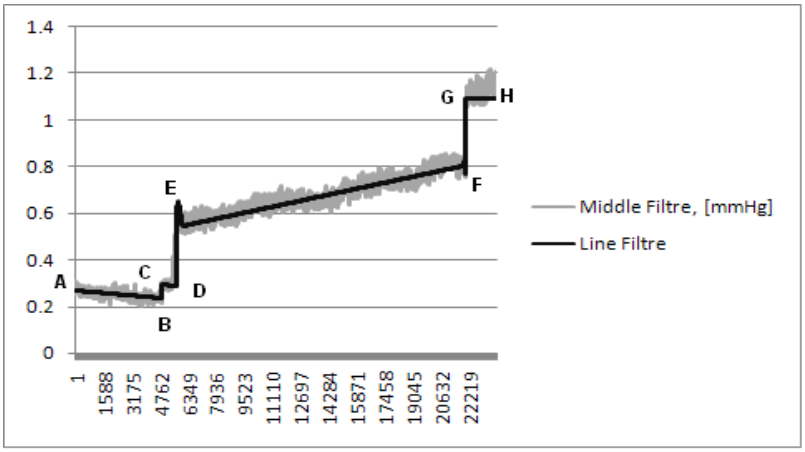


Fig.1. Straight linear filtration of slowly changeable signal at high frequency components.

2. Regular recurrent filtration algorithm of slowly changeable signal with imposed noise

The filtration makes smooth level of the graphics about the pressure signal function by linearization at every one its discrete step. For this aim a criterion about linearization is introduced:

$$\mathbf{x_c} = \sum_{i=1}^{I} \sum_{j=1}^{J} (\mathbf{x_i} + \mathbf{x_j}) / \mathbf{n} \qquad (3)$$

where i, j – character values of different kinds at explored discrete signal, n≥2 – step of linearization. In the case of regular recurrent algorithm this procedure is repeated consequently many times along with results, computed on the previous stage of programming actions. Applied on every one discrete step, this criterion allows the restored filtered signal to be built with high degree of compliance to the original noised measured signal. In parallel, the smooth variations of the signal keep their shape, and drop variations of high noisy frequencies decrease their amplitude at each one cycle of whole aggregate array. One only recurrent whole array cycle with the above criterion bring weak visible changes (fig. 2, a and fig. 2, b). Many cycles provide quite smoother filtering result. It can be controlled by criterion on recurrence as ratiocination:

$$\text{If } \mathbf{C_f \leq C_{th}} \text{ then } \mathbf{Cycles = Cycles + m,\ m \geq 3} \qquad (4)$$

It is based on coefficient of filtration $\mathbf{C_f}$ and its threshold $\mathbf{C_{th}}$. The expression 4 is valid for positive values of the coefficient of filtration $\mathbf{C_f}$ and its threshold $\mathbf{C_{th}}$. The sign of the inequality between them will be converted at negative values of both $\mathbf{-C_f}$, $\mathbf{-C_{th}}$. The value of negative threshold $\mathbf{-C_{th}}$ can also be different.

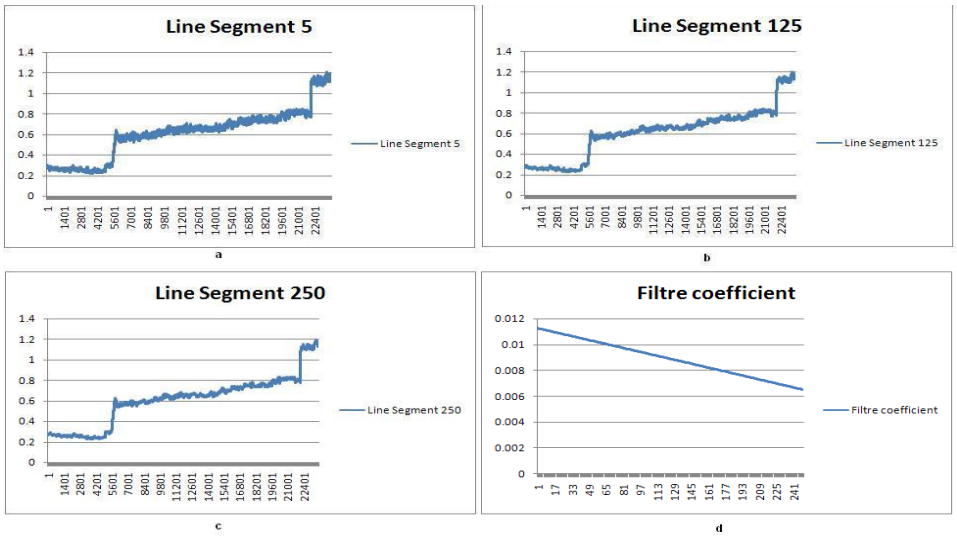


Fig. 2. Recurrent filtration graphics at different stages of regular algorithm and coefficient of filtration.

Application of the criterion 4 at large variations the values of thresholds $\mathbf{C_{th}}$, $\mathbf{-C_{th}}$ can turn the program into infinitive cycle on, especially when the smoothing activity at **m** cycles can be not sufficient. In parallel, important fluctuations, and the high amplitude of high frequencies variations remain into the signal even at large number of recurrent cycles. An instant application of that algorithm is shown on fig. 2, where three sequent images a, b, c belong to corresponding recurrence whole cycles 5, 125, 250, and the difference between them is expressed by slow diminution of the signal graphics. Numerically, the assessment of the graphics can be completed by coefficient of filtration as follows:

$$\mathbf{C_f = 1/K \sum_{k=1}^{K} (x_k - x_c)} \qquad (5)$$

An instant application of the regular recurrent algorithm with coefficient of filtration is presented on fig. 2, d.

3. Heuristic Recurrent Algorithm of Straight Linear Filtration the Pressure Signal

The algorithm of straight linear filtration aims conversion of the noise drop pressure signal graphics into a set of line segments (see fig. 1). They are submitted to rules, exposed in prior publications [3, 4] of earlier explorations. The algorithm uses results of a program procedure with definition of the boundary points of the pressure signal, determined by threshold of high transition, and thus it is recurrent. In parallel, the recurrent algorithm of straight linear filtration steers by extremes of the wave signal, explained in [4]. Thus, the sensitivity of determination the key pressure points A, B, C, D, E, F, G, and H about line segments grow. Hence the condition about intermediate boundary points of straight linear line segments has the following expression:

$$\mathbf{C_{bp} \subseteq \{[(\Delta x_i / \Delta t_i) \geq \delta_{pr}]\} \cap \{ [t_i \in (L_i \cap T_i)]\} \cap \{t_i \in T_{wj}\} \cap \{x_i \in X_{wj}\}} \quad (6)$$

where $\mathbf{\Delta x_i / \Delta t_i}$) – local speed of the pressure signal; $\mathbf{\delta_{pr}}$ threshold of grow the local speed, $\mathbf{L_i}$ **–** range of level the pressure signal at i-point; $\mathbf{T_i}$ - time range of the i-point; $\mathbf{T_{wj}}$ – time range of independent j-wave; $\mathbf{X_{wj}}$ – pressure level at the range of j-wave. The boundary points inside the ranges of first and second low waves deserve special interest as domains of specific systolic accelerations. The condition about those points can be expressed as follows:

$$C_{abp} \subseteq \mathbf{\{[(\Delta x_i / \Delta t_i) + [(x_{n+1} - x_i) / (t_{n+1} - t_i)] \geq \delta_{pr}]\} \cap \{(y_n \rightarrow \text{extreme}; x_n \rightarrow \text{extreme})\} \cap}$$
$$\mathbf{\cap \{[t_i \in (L_i \cap T_i)]\} \cap \{t_i \in T_{wj}\}} \quad (6')$$

where **y** – wave signal, **x** – pressure signal.

The boundary points are connected with concern the rule of straight linearity, as follows:

$$\mathbf{[X_i] = x_{0i} + sign(\Delta x_i) \cdot \sum_{i=1}^{I} (x_{ei} - x_{bi}) / (t_{ei} - t_{bi})} \quad (7)$$

where I=8 – number of boundary points and corresponding line segments or their ranges; e, b – end and beginning points of a line segment.

The filtered pressure signal can serve for computation of the main sphygmomanometer parameters – systolic and diastolic blood pressure with use the formula, known since the prior explorations [3, 5].

The discrete straight linear filtered signal of pressure $\mathbf{x_c}$ is assessed by computation of an integral filter coefficient, whose discrete analogue is determined with eq. 5. The graphics on fig. 2 d demonstrates the regression trend of these coefficients about a number of regular recurrent filtration cycles. At the next exposition the filter coefficients are computed for the straight linear filtrations, as well. The low values of this coefficient support high degree of proximity between straight linear and noise original signal, and the high quantitative values – their increasing distance.

4. Results of Computer Based Execution of the Filtration Algorithms

The computer model processes data of twelve computer based measurements of blood pressure with electric sphygmomanometer [5], connected to desktop computer. Each one measurement contains two aggregate arrays with around 20 000 values – issues for pressure

signal and same for the wave signal. They are modeled discrete values of computer restored signals obtained by scanning of analogue to digital converter with 500 Hz and electric range of about 2.5 V. The restored pressure signal is shown on fig. 1. In order to manifest the model activity, the results of the first one measurement are implemented here.

The first computational procedure reads the locations of sequence of points A, B, C, D, E, F, G, H (fig. 1), which are computed with a model, presented in [3]. The input point locations are processed with high sensitive procedure on accurate positioning by time discrete quantification. Hence, the graphics of filtered straight linear pressure signal can built. Its discrete values are used at assessments of regular recurrent algorithm, as well. The work of that procedure finishes with computation the systolic and diastolic blood pressure, shown on table 1.

Table 1. Comparison of modelled filtered signal values about BP and measured ones.

file No	Measured SBP	Measured DBP	Computed SBP	Computed DBP	Difference of SBP, %	Difference of DBP, %
file No 1	132	79	133	70	-0.758	11.392
file No 2	134	79	129	69	3.731	12.658
file No 3	116	70	118	65	-1.724	7.143
file No 4	130	74	116	74	10.769	0.000
file No 5	122	73	128	64	-4.918	12.329
file No 6	126	65	140	84	-11.111	-29.231
file No 7	107	72	131	79	-22.430	-9.722
file No 8	117	76	124	71	-5.983	6.579
file No 9	112	74	124	68	-10.714	8.108
file No 10	115	77	114	53	0.870	31.169
file No 11	111	68	115	59	-3.604	13.235
file No 12	120	81	116	68	3.333	16.049
Average	120	74	124	69	-3.54484	6.64249

In parallel, the deviations of the modelled filtered from the measured values are computed. They exceed the same deviations of the original signal relatively to the measured ones (see results of [3, 4, 6]) and in this reason the filtration introduces some additional inaccuracy about blood pressure.

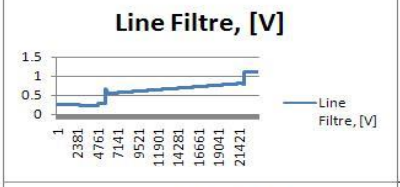
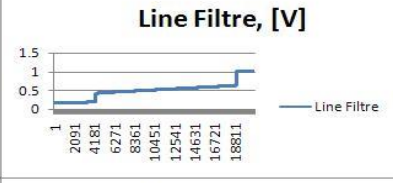
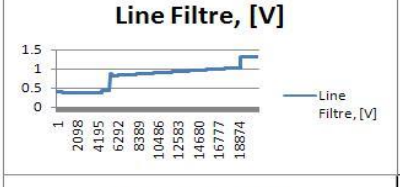
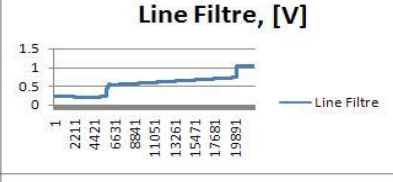
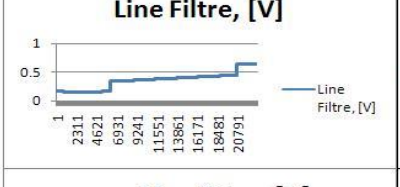
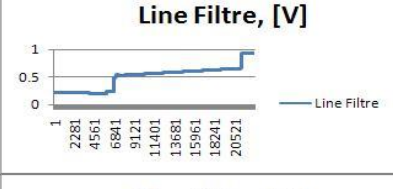
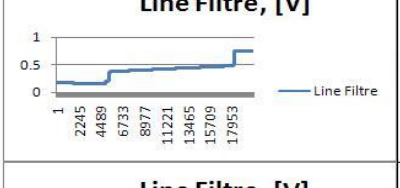
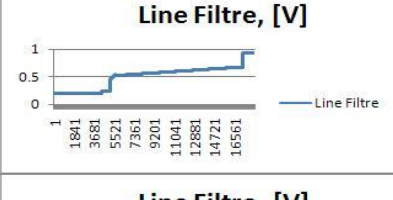
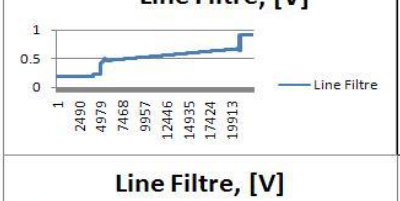
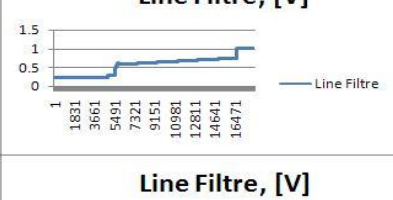
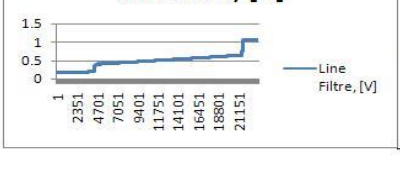
The graphics of straight linear filtered pressure signal and corresponding assessments by filter coefficient are presented on table 2. They are assessed by maximal values of the filter coefficient.

A brief program procedure completes the regular recurrent algorithm of filtration and assesses the filtered arrays on each one large cycle. It works at important duration of about 15 minutes and more. The filtering volume of computations at each one discrete signal step yields local amplitude smooth and general graphics diminution keeping the weakly wave nature of the mean pressure signal. As result of recurrence a minimal filter coefficient is achieved at 250^{th} cycle and the graphics on fig. 2, d affirms that it is not a limit.

For some measurements the filter coefficient passes through the zero point. At this case the pressure signal still remains with drop noise, but algebraic sum of deviations is close to zero. From one side, suppose the introduced filter coefficient does not provide absolute assessment information about the quality of filtration and some complex parameter will

perform this function in a better way. On the other side, suppose the filter coefficient can vary until the perfect line of the pressure signal is achieved. This task deserves a deeper exploration.

Table 2. Straight linear filter graphics of the pressure signal and filter coefficients.

	0.0114837		0.022843
	0.01226		0.003828
	0.010529		0.008831
	0.004383		-0.00346
	-0.00755		0.002992
	0.015926		-0.00228

Analysis of straight linear signal by filter coefficient on table 2 shows high degree of proximity to the original. The coefficient varies around 0.02 or 2% deviation of the filtered from the original signal of blood pressure. Together with the good quality of the filtration the computed blood pressure values increase the distance to the measured ones (table 1). Hence, the differentiation between the filtering procedure and computation of the blood pressure will be pointer about a style with impact on accuracy.

The filtration regular algorithm provides graphic analogue on fig. 2, c going nearby to the straight linear one. In parallel to the better filtered line quality, this algorithm decreases the noise slowly and with a cost of many cycles of filtrations. Moreover the central graphic line remains away of the filtered lines. This more accurate filtration could serve for deeper explorations on the pressure signal. The aims of the current exploration require fast results and the large duration of the regular algorithm makes it not enough efficient.

5. Conclusions

The regular recurrent algorithm of filtration the pressure signal of duo control electric sphygmomanometer is characterized with gradually shrinking the noise amplitudes, keeping the soft fluctuations at the graphics of the signal and low values of the filter coefficient with a good level of the restoration. Its quality can be improved with introduction of additional principles of build and assessment. The long duration at work of corresponding program decreases the efficiency especially at exploration of short term processes, like the process of blood pressure measurement.

The recurrent algorithm of straight linear filtration along with the boundary points of piece wise graphics is suggested by the author in this paper. It achieves permissible filtration at small number of recurrent procedures. In parallel, the weak fluctuations of the signal are also removed, which decreases the accuracy at signal restoration. The deviations of the computed in comparison to the originally measured values of the blood pressure grow up. This circumstance imposes differentiation of the program actions.

The low values of filter coefficient about assessment of the filtered graphics demonstrate good smooth quality. The programs are completed on Excel.

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Some Considerations on Choosing a Disaster Recovery as a Service Solution

Asen Bozhikov

Tsenov Academy of Economics, Svishtov, Bulgaria
a.bozhikov@uni-svishtov.bg

Abstract. The acceptance of the concept of public cloud is growing with every year and so is the number of cloud-based disaster recovery service providers. Disaster recovery as a service is getting more attractive for small and medium-sized enterprises as a flexible disaster recovery solution offering faster recovery times, cost savings and user friendly experience. The purpose of this paper is to review some key considerations which should be taken into account when moving to a cloud-based recovery solution.

Keywords. Cloud computing, Disaster recovery, Disaster recovery as a service, Downtime.

1. Introduction

The widely used model of cloud computing and its associated services which are available on-demand put a new light in the area of disaster recovery. In the literature we could find many definitions about what cloud computing is. A meaningful definition is the one of the US National Institute for Standards and Technology (NIST): *"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."* [13].

In the beginning, the concept of the software as a service was the most common application of cloud computing. Later we observed the appearance of two other cloud services: platform as a service (PaaS) and infrastructure as a service (IaaS). Somewhere in the end of 2009 we could mark the appearance of the first providers for cloud backup and recovery. They have offered a combination of storage as a service and replication as a service for a cost-effective data protection [7]. Although both of these cloud services are different in their nature and purpose, grouped together they allow to be covered all aspects of creating and restoring backup data, which are the most valuable asset of every business organization. As a result, in some degree this removes the restrictions on significantly reduced IT budgets of small and medium-sized enterprises by providing them with new opportunities for storage and maintenance of backup and disaster recovery.

Some of the most commonly used variations of cloud services for backup and recovery are the following: disaster recovery as a service (DRaaS); backup and restore to/from the cloud; replication to the cloud [10]. The purpose of this paper is to review the benefits and drawbacks of disaster recovery as a service solution and to emphasize on some key considerations when choosing that kind of solution.

2. Benefits and Drawbacks of Disaster Recovery as a Service

Disaster recovery as a service is a fast-growing cloud based solution for recovery, which lowers the level of complexity of the disaster recovery process. The emergence of

DRaaS is closely coupled with the advance in server virtualization, cloud computing and backup software. We could say that server virtualization has a significant footprint in the way we accomplish disaster recovery today. Cloud service providers use it to guarantee fast recovery times for applications and even virtual machines. The main idea is the replication of virtual machines and in some cases of physical servers to cloud provider's data center [3]. This enables the business organization to redirects its systems to the cloud in case of some unforeseen events in the main data center.

Many of the cloud service providers usually offer disaster recovery as a service. The most common model for that service is the hybrid model with the replication of backups as mentioned before. Some of the cloud providers are large organizations which have data centers located all over the world. An example for this are companies like Sungard, Microsoft and IBM which continue to extend their portfolios of cloud services. On the other hand, there are some smaller cloud providers on the same market which partner with backup software vendors and thus offer cloud recovery solutions (Asigra, etc.). As of June 2016 Gartner has identified more than 250 cloud providers which offer DRaaS and according to the research company it is expected that the use of the cloud recovery services will increase with more than 200% by 2020 [8].

One of the main benefits of DRaaS is that it's not necessary for the business organization to make large capital expenditures for purchasing hardware and software (which is a necessity in the case of building secondary data center) [2]. Instead, the payments are based on the subscription model. In most cases business organization pays fixed amount of money, depending on the volume of data stored in the cloud and the computing resources which are used. There are also providers of such services that allow adjusting the service to the specific needs of the business organization. Although it is a good solution, it may affect the price that is paid towards improving the recovery service.

Along with the low capital expenditures of choosing such a solution another benefit is the relatively short time of its implementation in the business organization since there is no need to purchase servers and install and tuning them. Cloud recovery service can be configured and ready for use for a relatively short period of time. Also a positive fact is the possibility for testing the DRaaS without interrupting the production environment. That way the disaster recovery plan could be tested more often, which is crucial for successful recovery if unexpected event occurs. Previous research has shown that only one third of the business organizations have tested their disaster recovery plans on a regular basis which means at least one per quarter [12].

It should not be overlooked the fact that the whole business model of a cloud service provider for disaster recovery is oriented mainly around coping with unforeseen events. This is a prerequisite for an in-depth knowledge of its staff on this particular subject (disaster recovery), which as a result leads to a high level of service support and competent and expert problem solving oriented to the subscribers (business organizations, using DRaaS) [9].

As with any other cloud service along with the advantages there are some challenges that should be considered before choosing that solution. The first one is related to the ability of the cloud service provider to maintain all of the subscribed business organizations within the available computing resources in its data center. Most of the time the subscribers are using a shared infrastructure of the provider which means that same servers are shared between multiple users assuming that they will use them at different time and the workload will be balanced. Hypothetically, however, there might be a situation in which many subscribers need to shift their operations to the cloud site and it appears that resources are not available to all of them.

Another potential problem could be the geographic location of the cloud provider's data center. It should be located away from the business organization's production environment and if possible to be in a completely different region, thus avoiding problems with it in case of regional disaster. As a rule, the cloud provider must have at least two data centers which are located in different regions, thus ensuring high availability to the subscribers. As we've mentioned before this is not so difficult to accomplish for large companies like Microsoft and IBM, while the smaller ones often rent parts of the data centers of the big players on the market. Not so obvious problem, but related to the location of the cloud provider data center is the one concerning the performance of the applications which should communicate with the cloud. Using Internet as a medium of communication suggests the occurrence of difficulties when transferring large data files, which in turn can lead to slowdown in application performance.

The price of the service is another factor to consider. Previous research has demonstrated that DRaaS is a cost-effective solution for small and medium-sized enterprises [5, 6]. But before choosing the cloud provider it's important for the business organization to have clear understanding of the price model for using the DRaaS. According to Alhazmi and Malaiya the yearly cost of cloud DR solution could be grouped in the following three categories [4]:

- Initial cost: amortized annual cost
- Ongoing cost: storage cost, data transfer cost and processing cost
- Cost of potential disaster: cost of disaster recoveries plus the cost of unrecoverable disasters.

Along with the usual monthly fee it might turned out that there are additional fees to be paid in case of using more computing power, disk storage and network bandwidth. Some cloud providers also offer on their sites a calculator or pricing guide for estimation of the cost depending on the needs of the business organization.

Service level agreement (SLA) of the cloud provider is something that shouldn't be underestimated. It states the downtime and response time when a problem with the service arises. Therefore, when choosing cloud solution for recovery subscribers must take into account the values for availability, recovery time objectives and recovery point objectives specified in the SLA and if necessary to negotiate these values with the cloud provider so that they meet the expected real needs that will arise with the execution of the disaster recovery plan. According to Gartner's specialists there should be a clause in the SLA which arrange the conduction of periodical audits of the cloud provider's infrastructure by IT security company/service provider [1].

All of the aforementioned positive and negative factors should be taken into account when considering moving the disaster recovery to the cloud. There are many cloud providers that offer DRaaS using different technologies but not every solution faces the needs of the business organization. As stated by Vasu Subbiah, vice-president of Products at CloudVelox Inc., there are four key factors that business organization have to address when deciding which cloud provider to choose [11]:

- Experience in the market of cloud services
- Fully managed DRaaS approach
- Clearly defined service level agreement
- Security and compliance with standards and regulations

It is a common practice on the sites of the cloud providers to exists a document or an article which emphasize on these key factors to consider, according to the current cloud provider.

3. Conclusion

Cloud disaster recovery gives small and medium-sized organization the chance to use the same capabilities that larger organizations have used for years. The review of the advantages and disadvantages of DRaaS clearly shows that there are many factors that need to be considered when choosing a cloud solution for disaster recovery.

Nevertheless, there is a place for that type of services in the portfolio of services offered by the cloud providers. On the one hand, it is a business opportunity for cloud providers while on the other hand, it is a comprehensive disaster recovery solution for the business organizations that makes them more resilient.

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Security in the Supply Chain of ICT Companies

William Dimitrov[1], **Galia Novakova**[2]

[1] University of Library Studies and Information Technologies, Sofia, Bulgaria
wdimitr@gmail.com

[2] Sofia University, Faculty of Mathematics and Informatics, Sofia, Bulgaria
g.novak@fmi.uni-sofia.bg

Abstract. For any modern organisation, physical supply chain management already presents numerous complex challenges in understanding exposure to risk. The added complexity of cybersecurity risks only amplifies this, regardless of their position within a supply chain. This paper provides a discussion to cyber-security risks within the supply chain, drawing on recent examples to highlight the benefits of an inclusive approach. While businesses open up their ICT infrastructures of collaboration with other businesses as supply chain or ecosystem partners, there is little or no evidence that such kind of partners collaborate in the area of cybersecurity. Organisations do not think that the connection point between them might be a weak link. They must accept this reality and stop addressing cybersecurity as a series of discrete problems. The only way to address the growing attack surface is with a comprehensive strategy and integrated controls. Internal and external IT infrastructure should be viewed as a holistic attack surface and addressed accordingly. It concludes with non-technical mitigation advice and points the reader to building thrust approaches and international standards for information security and management.

Keywords. Information security, Supply Chain, ICT companies'

1. Introduction

The revolution in ICT develops into a global environment based on open access to the world market. This global market provides significant benefits for companies manufacturers. Meanwhile, in relation to it are organized supply chains in ICT.
Politicians all over the world express concern about the global nature of supply chains due to fear of hostile actors abroad or locally, manipulation and sabotage of the systems of ICT. Director of the national intelligence service of the United States, for example, recently identified "many complex vulnerabilities associated with the supply chain for IT networks" as one of the greatest strategic challenges related to cybersecurity.

Two of our greatest strategic challenges regarding cyber threats are: (1) difficulty of providing timely, actionable warning of cyber threats and incidents, such as identifying past or present security breaches, definitively attributing them, and accurately distinguishing between cyber espionage intrusions and potentially disruptive cyber attacks; and (2) highly complex vulnerabilities associated with the IT supply chain for US networks. In both cases, US Government engagement with private sector owners and operators of critical infrastructures is essential for mitigating these threats [7].

Operation of supply chains in ICT today is critical to the security of governments and industry.

The present paper aims to expose key elements of the global security of supply chains in ICT and the importance of the topic for governments, industry and individual companies.

Simultaneously with the complexity of the systems of ICT is growing their number and scale and governments are increasing the application of COTS systems. Along with this increases the speed of developing new supply chains, elements of which are logically diverse and physically dispersed around the world.

Attention to this problem increases because of the lack of transparency, visibility and understanding to implement the security in the development, integration, deployment and use of technology. As well, there is insufficient control over the decisions that producers are taking regarding control of security risks in products and their insufficient capabilities and expertise to master these risks**Error! Reference source not found.** [6].

2. Risk in the Supply Chain of ICT Companies

The two main sources for precise definition of corporate sustainability are the Brundtland Commission's Report [1] and John Elkington's writings [2]. The first source defines the sustainable development as: "Development that meets the needs of the people today without compromising the ability of future generations to meet their own needs." The second source defines the sustainability at corporate level using the concept of Triple Bottom Line (TBL, 3BL or BL3). This concept is also known as the three sustainable business pillars or the three P's – People, Planet and Profit. That means that to be sustainable as a whole, the business has to be sustainable in its basic three aspects – economic (financial), social and ecologic (environmental).

The significant increase in the number of different actors in creating a product or service points out attention on the security risks of the product. It becomes obvious that the supply chain in ICT is not immune to threats [4]. **Error! Reference source not found.**

Supply chain is a system of organizations, people, technology, activities, information and resources involved in moving a product or service from supplier (producer) to customer. Supply chain activities transform natural resources, raw materials and components into a finished product that is delivered to the end customer. In sophisticated supply chain systems, used products may re-enter the supply chain at any point where residual value is recyclable [5].

Many organisations struggle to protect the confidentiality, availability, and integrity of their networks and systems in such a rapidly evolving cyber threat landscape.

Complex information and communication technology (ICT) services and support are often outsourced in an attempt to reduce infrastructure costs or streamline organisations.

Almost every organization experiences problems due to software or hardware malfunctions but typically these events are little more than inconveniences, although they have the potential to be devastating. However, deliberate cyber threats may reach the organisation through any number of vulnerable points along the supply chain [9].

The supply chain is actually an extremely complex information management system, and products and services provided by ICT supply chain are used to transfer and carry large amounts of data. Companies in the supply chain often need to share inventory information, the demand for information, sales information, forecasts, customer data and technical documentation and so on. It provides the hostile a very easy way to access or tamper with the internal information and resources to make disruptions [14].

Today security risks in the supply chain software and hardware are determined by:

- the substantial increase in human and technical artifacts that "touch" the products and services;
- bad components or quality of service and poor management practices on security;
- lack of clarity and understanding for development, integration and implementation of the technology so as to guarantee its security and;

- lack of control over decisions that affect the inherited risks and the ability to effectively reduce these risks.

As the software industry has become increasingly globalized, a concern has risen over the possibility that an IT solution could be compromised by the intentional insertion of malicious code into the solution's software during its development or maintenance. This type of attack is often referred to as a supply chain attack. A supply chain attack can be directed at any category of software, including custom software, software delivering a cloud service, a software product, or software embedded in a hardware device **Error! Reference source not found.**[12].

The control in the process of commercial software development is mostly directed to the design and quality of the code. This determines the appearance of program code, which lefts the door open for individuals or governments with conflicting interests. The positioning of such a code in the supply chain is leading to the moment it takes the distance to the end users and ended up in their constructions of ICT. So interested persons and governments receive access to their infrastructure goals.

In the same way as the software exists concern about safety and quality of the hardware components. The existence of counterfeit products is also subject to the context of security. Risks associated with fake hardware may include the presence of "fake" products, and the sale or use of old parts that are presenting as new within the processes of the supply chain. Other potential risks include installation of malware, viruses, or other harmful objects on devices in the production process, leaving the device vulnerable to remote control and exploitation, even directly with potential for destruction once they are installed in the middle of the user.

ICT products are often designed and built in different locations by using components that are produced in different parts of the world. This makes it very difficult to define the products to be manufactured in a particular country. For example, a recent GAO's study outlines the complexity of the supply chain for a laptop. [2**Error! Reference source not found.**]:

Table 1. Potential Origins of Common Suppliers for Laptop Components [15**Error! Reference source not found.**]

Component	Manufacturers
LCD	China, Czech Republic, Poland, Singapore, South Korea, Taiwan
Memory	China, Israel, Japan, Malaysia, Puerto Rico, Italy, Philippines, Singapore, South Korea, Taiwan, USA
Processor	Canada, China, Costa Rica, Ireland, Israel, Malaysia, Singapore, USA, Vietnam
Mother plate	Taiwan
Hard dick	China, Ireland, Japan, Malaysia, Philippines, Singapore, Thailand, USA

Companies in the ICT sector perform different functions (research, development, production, supply of services) in production facilities, which are scattered around the world. This undermines the classification of products to the alleged "made in country X". To remain competitive, companies must continue to use distributed approach to development and production.

The global ICT industry depends on a flexible global supply chain. The latter is

characterized by intense competition and fluctuations in prices and demand. Requirements of the market are such that it would be impractical for the commercial sector to eliminate the use of global resources, which is tantamount to a distributed model of the supply chain. As a result, the emphasis on security issues of supply chains should be on how to make a product, not where.

A group of commercial providers of ICT formed organizitsii called SAFECode. It endeavors to identify and promote best practices for developing and delivering more secure and reliable software, hardware and services. This initiative defines a framework for the integrity of the supply chain software, which provides a common taxonomy to assess the risks in software engineering and outlines the role that industry players should play in these risks. SAFECode is coordinated with Software Assurance Forum of DHS.

3. Building Trust in the Supply Chain

Number of elements can be used for building trust in the partners.

According ENISA there are a number of elements that may be used to build trust in SC (Supplay Chain) partners that include: personnel identification and authentication; access management; past and current financial performance; past and current SC performance.

There are technical means to determine if the entity at the end of the SC is a genuine representation of the SC (noting that each SC link, or node, may modify one or more components). At the technical level supply chain integrity can be assured within a secure environment, through secure development and through authenticity proofing of the end product:

Secure environment in this instance is an environment in which intentional insertion of malware or other intentional tampering with a product or service during product development or production operations has been mitigated.

Secure development and production is that set of processes and procedures deployed in order to give assurance that the quality of the final product (as well as any intermediate products) is within the contractual boundaries.

Authenticity gives assurance of the genuineness of the final product as coming from a managed supply chain [5**Error! Reference source not found.**].

Supply chain of ICT contains a full set of key actors which until now were considered involved in the life cycle of a corporate network infrastructure. End users, managing development policies, supply specialists, system integrators, network service providers and manufacturers of software and hardware.

Communicating in organizational and process level with each other, these users and suppliers generally called key actors, plan, build, manage, accompany and protect the network infrastructure of an organization.

Compared to the traditional supply chain ICT one has its own characteristics. The equipment that is used in the ICT typically includes hardware, software, and many other components. It is difficult to test and measure the performance and quality of hardware equipment and software. We would say that even qualitative assessment of the equipment is not easy.

Finally, we note that the supply chain in ICT is a critical part of the remaining supply chains. The consequences of having a security hole in the supply chain in ICT can lead to blocked or hampered all dependent on it chains [14]. What will be the result if it stops information system for purchasing tickets for flights or this supply of printer consumables in a bank? The breakthrough in the information system of the company TARGET began with penetration into the information system of the subcontractor where malware be transferred in the IT infrastructure of customer.

A series of steps were taken by the adversaries to obtain access to the credit card data

and retrieve it from Target's systems. A break down in detection further increased data loss. Sources suggest the breach transpired as follows: Reconnaissance by attackers may have included a Google search that would have supplied a great deal of information about how Target interacts with vendors. Results would have revealed a vendor portal and a list of HVAC and refrigeration companies. This reconnaissance would have also revealed a detailed case study on the Microsoft web site that describes how Target uses Microsoft virtualization software, centralized name resolution and Microsoft System Center Configuration Manager (SCCM), to deploy security patches and system updates.

In mid-2014 it was identified cyber espionage group known as Dragonfly (also known as Energetic Bear, Havex and Crouching Yeti), actions which were directed at businesses across Europe and North America, mainly in the energy sector.

This group is experienced in attacks on businesses through their supply chains. In one of its last campaigns Dragonfly put a trojan ("trojanise") and compromise legitimate software systems for industrial control (ICS). Malware includes functionality that provides remote control of systems in which it is installed. It is very difficult to understand that the system works with replaced, compromised software and there is no reason the company, which is the goal of the operation, to suspect anything. A newer approach used by the attackers involves compromising the update site for several industrial control system (ICS) software producers [13].

This example illustrates the reliance on security provider, since it is not possible to inspect every piece of hardware or software in sufficient volume and in depth, which are required to detect this kind of attack.

Increasingly, disruptions caused by problems with websites and computer networks are recognized as a significant supply chain threat. Disruptions could be a result of a software or hardware malfunction within a supplier's own system, or they could be caused by an external attack. An attack in the "cloud" – where a vendor that provides services to thousands or even millions of companies may be targeted – could cause widespread disruptions across many industry sectors. In an extreme, but increasingly probable scenario, massive disruptions could result from a large-scale attack on the infrastructure of an entire nation.

Supply chain vulnerabilities disruptions could be a result of a software or hardware malfunction within a supplier's own system, or they could be caused by an external attack.

"Supply chain" typically implies the movement of physical items, but in a world where digital assets often exceed the value of physical assets, the concept of supply chain needs to be expanded to include information and services. Organizations of all types rely on the Internet and various software tools and service providers to order and pay for supplies, to trade information with business partners and to transact business with customers. Interruption of those processes, even for companies dealing in the bricks-and-mortar world, potentially can be even more disruptive than damage to transportation infrastructure. [10]

4. Conclusion

With information and security arrangements shared across a supply chain, the cyber-security of any one organisation within the chain is potentially only as strong as that of the weakest member of the supply chain. A determined aggressor, notably advanced persistent threats (APTs), will make use of this by identifying the organisation with the weakest cyber-security within the supply chain, and using these vulnerabilities present in their systems to gain access to other members of the supply chain. Whilst not always the case, it is often the smaller organisations within a supply chain who, due to more limited resources, have the weakest cyber-security arrangements. Small organisations accounted for 92 percent of the total number

of cyber incidents analysed in Verizon's 2014 Data Breach Investigation Report [3**Error! Reference source not found.**].

They are often targeted because they are more vulnerable, represent a single point of failure, or have disproportionate access to important information given their size within a supply chain.

This poses a particular risk for larger companies on whom they depend. The smaller firms they contract to produce the niche products required expose them to potential compromise regardless of their own cyber-security maturity [9].

As a result of studies, it is clear that in recent years it is no longer sufficient the risk assessment for IT security to be based on threats, surface threats vulnerabilities and exploits. The weakest link in the supply chain is hot paradigm that needs to be taken into account when assessing risk for IT security. At least cybersecurity is new aspect of supply chain risk management.

Finally, we allow ourselves to recommend those who want to do further testing to try to explore opportunities for similar application in ICT technology asset integrity management risk assessment method applied in organizations that have long experience, albeit in another area, such as OGI (Oil and Gas Industry) [8], which essentially refers to the ISO 31000 [1]. Experience with ISO 27000 indicates that the Standards are increasingly recognised as one method of measuring the level of information security management and maturity in the supply chain [11]

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Implementation of Data Driven Calculation of Merchant Service Fees and Commissions Approach for an Acquiring Bank

Monika Tzaneva, Dorina Kabakchieva

UNWE, Sofia, Bulgaria
mtzaneva@unwe.bg , dkabakchieva@unwe.bg

Abstract. Card payments in retail industry require complicated payment systems for facilitating purchase transactions. The calculation of fees and commissions for the acquiring banks, providing merchant services for card payment enablement, is a problem that focuses the attention of banking and financial experts, researchers and policy makers. The main purpose of this paper is to present a new approach that is proposed for the calculation of merchant service fees and commissions for an acquiring bank. The developed calculation procedure is data driven and provides important benefits for the acquiring bank, ensuring flexibility in the relations with merchants and Payment Service Providers.

Keywords. Merchant Service Fees, Acquiring Bank Fees, Data Driven Calculation of Merchant Service Fees

1. Introduction

Merchant acquiring is related to card payments in typical retail purchase transactions. The transaction flow includes several stages, involving cardholders and the card issuing banks, on one hand, and merchants and the merchant acquiring banks, on the other hand, as well as a payment network between them coordinating the information and money flow [1]. The transaction flow and the main stakeholders in the purchase transaction payment process are presented on Fig.1.

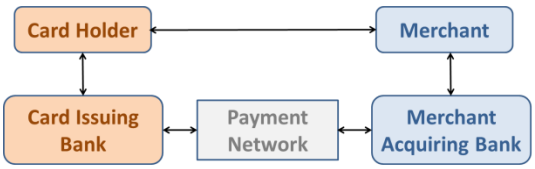

Fig.1. The transaction flow in card payment process

The payment systems facilitating the purchase transactions are very complex, involving a large number of consumers, merchants, banks and intermediary entities, ensuring the card payment processing [2]. The payment network is formed around the so called interchange fee, the fee that is usually charged by a consumer's bank to a merchant's bank in order to facilitate a payment card transaction [3,4].

Merchant services are the activities performed by the merchant acquiring banks for the implementation of the purchase transactions at the point of sale, enabling the merchants to accept the payment cards of their customers. The relationships between a merchant and the acquiring bank (the acquirer) are based on commercial contracts. The most common

commercial contract in Europe defines a fixed commission percentage called the Merchant Service Commission (MSC) [4,5]. The fixed MSC for all the transactions with the merchant is negotiated with the acquiring bank, depending on the volume and traffic (national/international) of the merchant transactions, as well as the estimated risk. The fixed MSC is also termed a blend rate because it blends in all different buying rates in one single selling rate for the acquiring bank. Insurance for the acquiring bank against changing buying rates is also calculated in the blend rate.

Another approach for calculating the acquiring bank fees is the so called Interchange Plus pricing, according to which the acquirer charges the merchant with a variable MSC consisting of the cost price plus a fixed markup. The variable MSC is different for the various transactions and depends on the transaction characteristics, including card type, channel (point of sale, e-commerce or call center) and security measures involved (Card Verification Code, 3-D Secure). The implementation of such an approach gives merchants insight in the cost of their payment traffic and can also result in a lower total payment cost. In the US and for corporate merchants, interchange-plus pricing is common practice.

The main purpose of this paper is to present a customized data-driven approach for the calculation of variable merchant service fees and commissions, proposed for an acquiring bank.

2. Organizational Structure of e-Commerce Acquiring Process

When merchants want to effect payments on their company websites, processed by credit card networks, they have to apply first to an approved Payment Service Provider, known as a "PSP" (Fig.2). The PSP function is to integrate the merchant's e-commerce enabled website with the international credit card networks so that orders generated by the selected "shopping cart" software can be authorized and payment collected for the merchant.

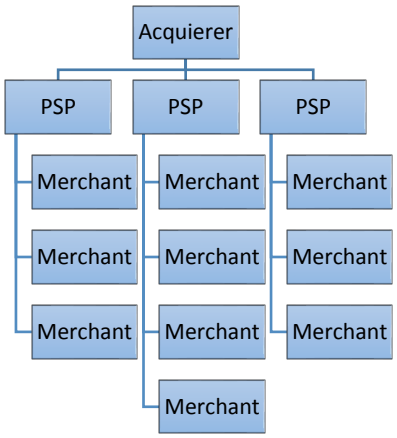

Fig. 2. Organizational Structure of e-Commerce Acquiring Process

The merchant has to go through an application process in order to get an agreement in place with a selected PSP. The PSP terms and conditions, as well as charges, vary enormously from one PSP to another, and therefore it is very difficult to make exact comparisons. However, merchants should be aware that whatever charges the PSP makes, they will be added to the charges levied by the bank providing the merchant account. Consequently, the merchant may end up paying two lots of set-up charges, monthly/annual fees, and, worst of all, two lots of percentages on every transaction.

Finally, when the application process for the selected PSP is completed, the merchant needs to confirm with the acquiring bank that they will accept Internet generated transactions. It must be noted that even when a Merchant ID is available it does not guarantee that the merchant will be allowed to use it for sales from the company website.

3. Database Structure for Calculating Merchant Service Fees and Commissions for an Acquiring Bank

A customized approach is proposed for the calculation of variable merchant service fees and commissions for an acquiring bank. The developed database structure is presented on Fig.3.

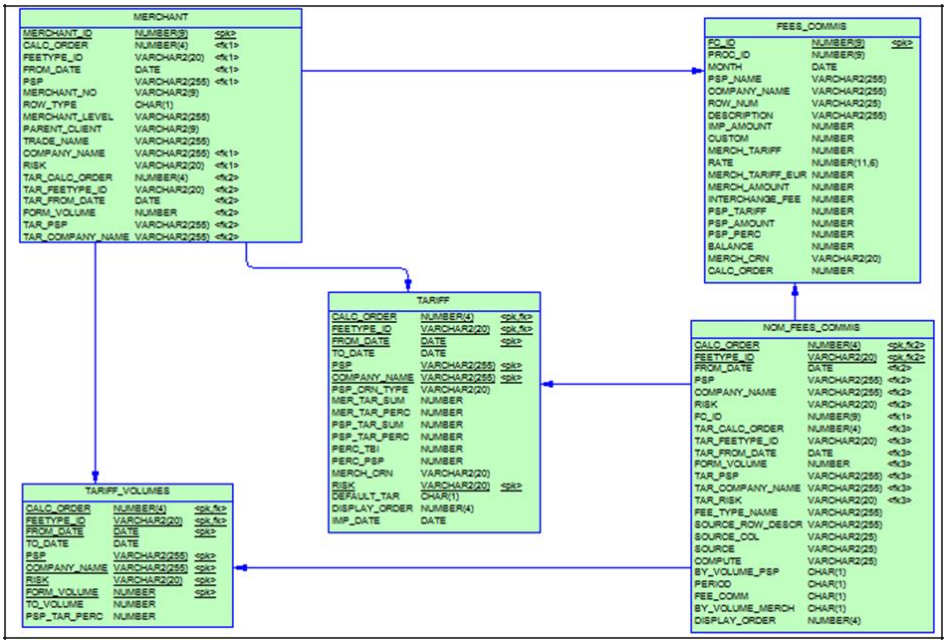

Fig.3. Database Structure for Calculation of Variable MSF for an Acquiring Bank

The system data is organized in 5 tables, providing information about the acquirers' fees and commissions, the tariffs and tariff volumes, and the merchants.

The entire calculation procedure is controlled by the data stored in the *Nomenclature of Fees and Commissions* table (NOM_FEES_COMMIS), setting:

- Processing and display order of the calculation steps;
- Type of fee or commission (fixed or floating);
- Full name of the fee or commission that must be calculated, as displayed in the reports;
- Data sources used for the calculation;

The main data source is the acquirer's GL, which contains the quantity (volumes) of transactions performed by each merchant aggregated by card type and transaction region, on daily basis. This data is imported every day from the Bank's accounting system. Depending on the merchants' daily activities, each GL file contains 8 to 15 thousand rows which are classified and aggregated by the computational procedure. Additional data sources include VISA and MasterCard currency rates imported at the end of each month and some other csv files with manually adjusted data about chargebacks, representments, wire fees, maintenance

fees, different types of account set ups, etc. All data sources contain both, amounts (in merchant accounting currency) and volumes of various merchant activities, so the calculation procedure "selects" the appropriate numbers based on the fee/commission configuration data.

- The name of the field from each of the above described data sources, containing the quantity data used for the calculation;
- The text used to filter the data rows from each of the above described data sources included in the calculation of a particular fee/commission;
- A Reference to an additional computation procedure, if such is needed (this is the case when a fee or commission is based on the Interchange);
- The type of the exchange rates (average or last day of month) used for the calculations.

The "TARIFF" table contains all the fixed tariff rates applicable for the PSPs and their merchants, and the "TARIFF_VOLUMES" table contains all the floating tariff rates applicable for each PSP. All the results calculated by the monthly execution of the "fees and commissions" computation procedure are stored in the "FEES_COMMIS" table.

4. A Data Driven Approach for Calculating Merchant Service Fees and Commissions for an Acquiring Bank

The workflow procedure for calculating the variable merchant service fees and commissions for the acquiring bank is presented on Fig.4. The first step is to identify the fee or commission that has to be calculated. Next, based on the fee or commission type, the data source is identified. That is followed by data aggregation for the calculation period (usually the aggregation is performed on monthly basis), depending on the fee or commission type, both for the merchant and the PSP. The next steps include identifying the valid fee/commission rate for the calculation period, again taking into consideration the fee and commission type, calculating the currency rates, calculating the amounts and balance (both for the merchant and the PSP), and calculating subtotals and totals.

The main benefits from the implementation of the proposed customized approach for calculating the merchant service fees and commissions are related to the flexibility that the suggested solution provides for the acquiring bank.

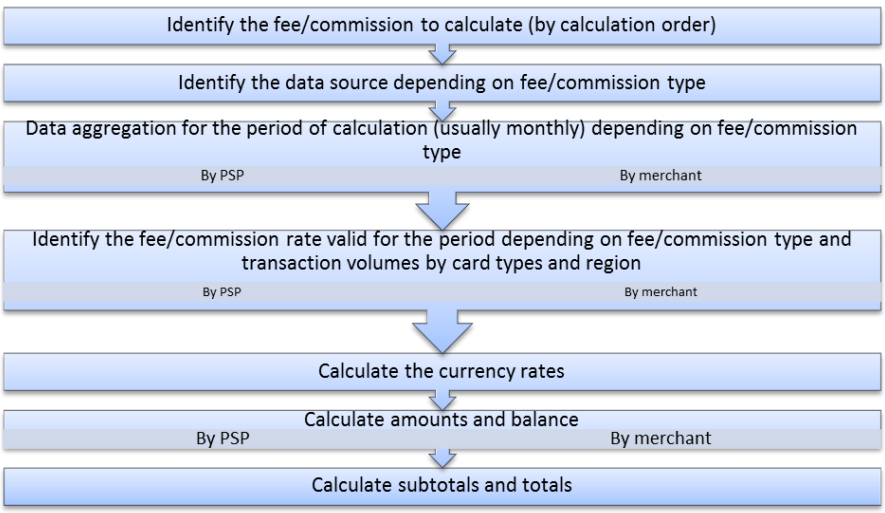

Fig.4. Calculation Procedure of Variable MSF for an Acquiring Bank

The following facts reveal the important advantages gained since the new calculation procedure implementation:

- The number of PSP serviced has been doubled and the number of merchants serviced has increased more than six times, without any needs of changes in the procedure;
- Two new types of commissions and eight new fee types have been configured without a single problem being reported;
- The calculation procedure runs less than 20 minutes to process more than half a million records in the source data.

Thus the Acquirer has the liberty to negotiate large variety of terms and conditions in PSP and merchants' contracts without worrying about any significant deficiency in system functionality.

5. Conclusion

The calculation of fees and commissions for the acquiring banks, providing merchant services for card payment enablement, is a very complex issue in payment systems facilitating electronic purchase transactions, and there is no standard well accepted approach. The proposed customized calculation procedure is data driven and results in substantially increased number of PSP and merchants serviced and high efficiency for processing large volumes of data, without the need for serious changes in the system. The implemented approach ensures flexibility for the acquiring bank, giving possibilities for negotiating larger variety of terms and conditions in PSP and merchants' contracts, without worrying about any significant deficiency in system functionality.

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An Approach for Risk Analysis of Drones Attack to Critical Infrastructure Objects

Plamena Zlateva, Valentin Penev, Gary Rowlands, Georgi Georgiev

Institute of System Engineering and Robotics - BAS, Sofia, Bulgaria
plamzlateva@abv.bg

Abstract. An approach for risk analysis of drones attack to critical infrastructure objects is proposed. In particular, the fuzzy logic model is designed as a hierarchical structure with four inputs and one output. The number of inputs corresponds to the linguistic variables (indicators), which described the characteristics of drones attack. The output represents a threat degree assessment, which is used for risk analysis of drones attack to critical infrastructure objects. Several computer simulations are carried out to validate the fuzzy logic model. The simulation results confirm that the proposed fuzzy model can be successfully used for risk analysis of drones attack to critical infrastructure objects.

Keywords. Drones attack, Risk analysis, Fuzzy logic model, Critical infrastructure.

1. Introduction

The drones are formally known as unmanned aerial vehicles (UAVs) or unmanned aircraft systems (UASes). Essentially, a drone is a flying robot. The drones can be remotely controlled or autonomously fly through software-controlled flight plans in their embedded systems working in conjunction with onboard sensors and GPS [2 – 4, 6].

The drones are of particular interest for airborne science because of unique features that enable missions not possible before. It needs to point that the drones can perform a number of specific activities compared to the manned aircraft [9]:

- Drones can be flown in dangerous situations, because there is no pilot or scientist on board. For example, drones can be flown through toxic plumes for in situ sampling.
- Drones can fly long duration, dull missions, such as mapping or for diurnal measurements, without inconveniencing pilot or crew.
- Drones with long endurance can loiter during an emergency, enabling long-term situational awareness.
- Drones with long range capability can be launched from a remote location, or flown to a remote location.
- Drones with high altitude capability can fly safely over weather and above air traffic.

In summary, drones can provide more temporal and geographic flexibility than satellites with fewer human risks and costs than manned aircraft systems [7]. Now, there are many varieties of drones. They range in size and payload capability from very small (carrying 5 lbs) to extremely large (carrying several thousand pounds) [8].

Improvements in robotics, artificial intelligence, additive manufacturing (also known as 3D printing), and nano-energetics are dramatically changing the character of conflict in all domains. The convergence of these new and improving technologies is creating a massive increase in capabilities available to smaller and smaller political entities extending even to the individual. This increase provides smaller powers with capabilities that used to be the preserve

of major powers. This increase provides smaller powers with capabilities that used to be the preserve of major powers. Moreover, these small, smart, and cheap weapons based on land, sea, or air may be able to dominate combat and to influence negatively to critical infrastructure [1, 5] and transport management [10, 11].

The purpose of this report is to propose an approach for risk analysis of drones attack to critical infrastructure objects. In particular, a fuzzy logic model is design as a hierarchical structure with several inputs and one output. The number of inputs corresponds to the linguistic variables (indicators), which described the characteristics of drones attack. The output represents a threat degree assessment, which is used for risk analysis of drones attack to critical infrastructure objects.

2. A Fuzzy Logic Model for Threat Degree Assessment of Drones Attack to Critical Infrastructure Objects

The fuzzy logic model is designed as a hierarchical structure with four inputs and one output. The number of inputs corresponds to the linguistic variables (indicators), which described the characteristics of drones attack. The output represents a threat degree assessment, which is used for risk analysis of drones attack to critical infrastructure objects.

In this study, four indicators for the threat degree assessment for risk analysis of drones attack to critical infrastructure objects using the expert knowledge and published thematic information. The indicators of the fuzzy logic model are input variables of the designed fuzzy system. The fuzzy system inputs are defined as follow:

Input 1 "*Air velocity*";

Input 2 "*Altitude*";

Input 3 "*Radius of turn*";

Input 4 "*Accuracy of PAN*".

The proposed fuzzy logic model is designed as a three-level hierarchical fuzzy system with previously defined four inputs. The every level includes one fuzzy logic subsystem with two inputs. The fuzzy logic system output gives the threat degree assessment.

A scheme of the three-level hierarchical fuzzy system is presented in Fig. 1.

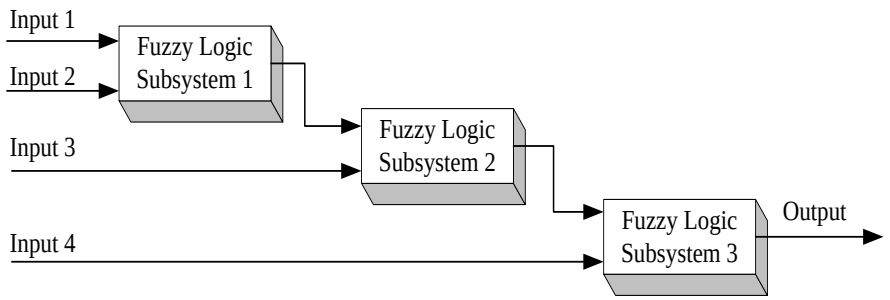

Fig. 1. Three-level hierarchical fuzzy system.

The inputs of the first fuzzy logic subsystem are Input 1 "*Air velocity*" and Input 2 "*Altitude*", and the linguistic output variable is defined as Intermediate variable 1 "*Air velocity - Altitude*".

The inputs of the second fuzzy logic subsystem are Intermediate variable 1 "*Air velocity - Altitude*" and Input 3 "Radius of turn", and the linguistic output variable is defined as Intermediate variable 2 "*Air velocity – Altitude - Radius of turn*".

The inputs of the third fuzzy logic subsystem are Intermediate variable 2 "*Air velocity – Altitude - Radius of turn*" and Input 4 "*Accuracy of PAN*". The output of this fuzzy subsystem is output of the whole fuzzy system. Here, the linguistic output variable is defined as "*Threat degree assessment*". This output variable gives a threat degree assessment of drones attack in regard to the defined four input indicators.

The value of the threat degree assessment is a criterion for final decision making about the seriousness of drones attack to critical infrastructure objects. The higher value corresponds to the higher seriousness of drones attack.

3. Design of Fuzzy Logic Model for Threat Degree Assessment of Drones Attack

Inherently qualitative features of indicators are rather than quantitative values, which are usually represented by linguistic variables. Information and decision are closely linked and different methods exist to make a decision on the basis of imperfect information. Expert judgements depend on quality and uncertainty of the available information that may result from measures, historical analysis, subjective testimonies, possibly conflicting, and assessments done by the experts themselves.

In proposed fuzzy logic model, the input linguistic variables (four indicators and two intermediate) are represented by three fuzzy membership functions: "*Low*", "*Middle*", and "*High*". The all input variables are assessed in the interval [0, 10] using trapezoid membership functions.

The fuzzy system output (threat degree assessment of drones attack) is described by five fuzzy membership functions: "*Very low*", "*Low*", "*Middle*", "*High*", and "*Very high*". The complex environmental risk is assessed in the interval [0, 100] using triangular membership functions. The input and output membership functions are shown in Figures 2-3.

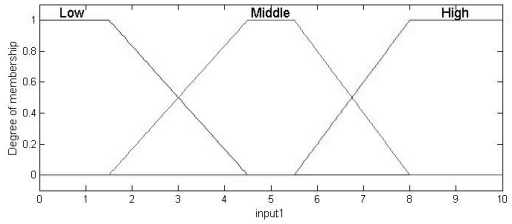

Fig. 2. Membership functions of the input variables.

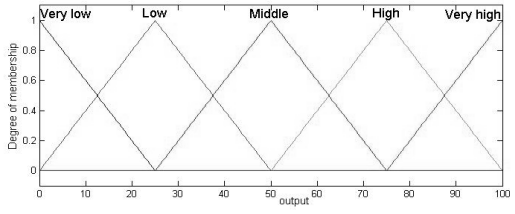

Fig. 3. Membership functions of the fuzzy system output.

The inference rules in the fuzzy logic system are defined through "IF - THEN"-clause. Rule numbers of the knowledge base per each of the fuzzy logic subsystems are 9. Some of the inference rules are defined as follow:

IF "*Air velocity*" is "*Low*" and "Altitude" is "*High*" THEN "*Intermediate variable 1*" is "*Middle*";

IF "*Air velocity*" is "High" and "Altitude" is "Middle" THEN "*Intermediate variable 1*" is "*Middle*";

IF "*Intermediate variable 1*" is "*Low*" and "*Radius of turn*" is "*Middle*" THEN "*Intermediate variable 2*" is "*Low*";

IF "*Intermediate variable 1*" is "*Middle*" and "*Radius of turn*" is "*High*" THEN "*Intermediate variable 2*" is "*Middle*";

IF "*Intermediate variable 1*" is "*High*" and "*Radius of turn*" is "*Middle*" THEN "*Intermediate variable 2*" is "*High*";

……

IF "*Intermediate variable 2*" is "Low" and "Accuracy of PAN" is "Low" THEN "*Threat degree assessment*" is "Very low";

IF "*Intermediate variable 2*" is "Low" and "Accuracy of PAN" is "High" THEN "*Threat degree assessment*" is "Middle";

IF "*Intermediate variable 2*" is "High" and "Accuracy of PAN" is "High" THEN "*Threat degree assessment*" is "Very high".

The fuzzy hierarchical system is designed in *Matlab* environment using *Fuzzy Logic Toolbox*. The three fuzzy subsystems are built in the Mamdani type fuzzy inference system. The inference surfaces in 3D for the three fuzzy logic subsystems are given on Figures 4-6.

4. Application of the Designed Fuzzy Logic Model for Threat Degree Assessment of Drones Attack

The designed fuzzy logic model for threat degree assessment is applied to the risk analyses of drones attack to critical infrastructure objects.

The results obtained from 5 simulations using sample data are shown in Table 1.

The results show the *Simulation 4* has the highest value of the *Threat degree assessment* according to the input data. The *Simulations* ordered by the decreasing degree of natural risk are 3, 1, 2, respectively. The *Threat degree assessment* is lowest for the Simulation 5.

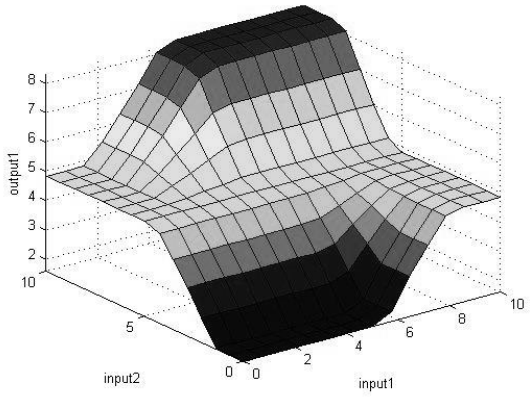

Fig. 4. Surfaces of the fuzzy logic subsystem 1.

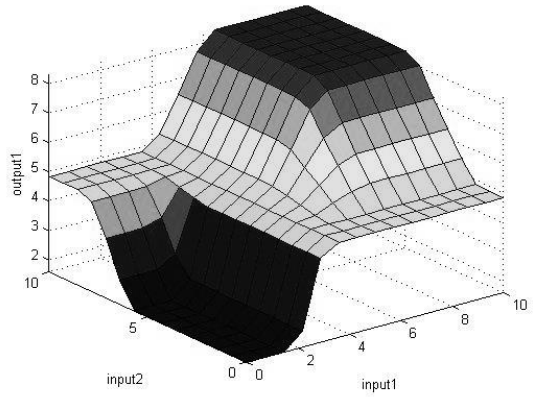

Fig. 5. Surfaces of the fuzzy logic subsystem 2.

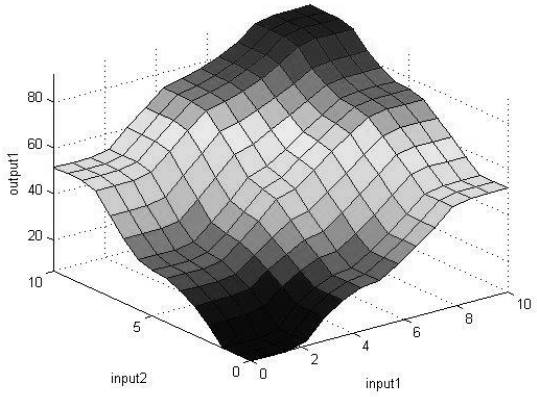

Fig. 6: Surfaces of the fuzzy logic subsystem 3.

Table 1: Simulation results

Criterion	Input 1	Input 2	Input 3	Input 4	Output
Simulation 1	8	9	7	6	77
Simulation 2	6	5	5	7	61
Simulation 3	9	8	6	8	82
Simulation 4	7	10	8	10	94
Simulation 5	6	4	3	6	49

5. Conclusion

An approach for risk analysis of drones attack to critical infrastructure objects is proposed. In particular, the fuzzy logic model is designed as a hierarchical structure with four

inputs and one output. The number of inputs corresponds to the linguistic variables (indicators), which described the characteristics of drones attack. The output represents a threat degree assessment, which is used for risk analysis of drones attack to critical infrastructure objects. Several computer simulations are carried out to validate the fuzzy logic model. The simulation results confirm that the proposed fuzzy model can be successfully used for risk analysis of drones attack to critical infrastructure objects.

In this study, we suppose that we know the parameters of the drone by which we evaluate the thread of unmanned vehicle. Next step is to use parameters, which are true at some degree. The proposed set of parameters and fuzzy set of rules are initial step in our investigations. We will continue the research with extending the input parameters and make the set of rules much more complex.

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A Discrete Kalman Filter Attitude Heading Reference System, using a Low Cost Micro Electro-mechanical Inertial Measurement Unit

Valentin Penev, Gary Rowlands, Alexander Shamliev

ISER - BAS, Acad. G. Bonchev Str., Bl. 2, 1113 Sofia, Bulgaria
vpenev@simsoftbg.com

Abstract. This paper presents the development of a low cost miniature AHRS (Attitude Heading Reference System), using a Low Cost Micro Electro-mechanical Inertial Measurement Unit. Targeted were those who require compact packaging and long endurance relative to size. With the maturation and advancement of semiconductor manufacturing technology, MEMS (Micro-Electrical-Mechanical Systems) sensors are increasingly used in flight attitude calculations. However, accuracy requirements usually can not be satisfied by using the inexpensive MEMS sensors. Therefore, some forms of Kalman filtering are employed to provide more accurate and reliable attitude information in the MEMS attitude determination systems.

Keywords. Attitude Heading Reference System, Micro Electrical-Mechanical Systems, Discrete Kalman Filter.

1. Introduction

The accurate measurement of orientation is an important role in many applications. With continuing research in the field of unmanned systems it is becoming a necessity to utilize smaller and less expensive components, which leads to the use of MEMS based IMU (Inertial Measurement Unit) providing less accurate readings. There are numerous companies that now offer low cost (<$10) AHRS sensors on the market. The use of low cost IMUs is primarily targeted towards Unmanned Aerial Vehicle (UAV) applications due to the requirements for small package size, lightweight, and low energy consumption. An AHRS consists of an IMU together with on-board computational ability to output vehicle attitude information in terms of yaw, pitch, and roll from the raw sensor data. The IMU is the collective term for a platform of sensors, which output measurements of the vehicles state, such as angular rates and accelerations. Typical low-cost IMUs consist of gyros that output angular rates about the three vehicle axes, accelerometers, which output acceleration (in terms of "g" units) along each of these three axes, and optionally magnetometers, which output the magnetic field flux density along each axis. These sensors can be implemented and mounted individually, but they are increasingly being integrated into a single small package, creating what is known as a '9 degree of freedom' IMU. Innovative action in MEMS technology based sensors is revolutionizing inertial navigation in UAVs. Size, weight, and energy consumption being of paramount importance. With the increasing performance in technology and decreasing size, the capabilities of UAVs are growing at a fast rate. Miniature sensors and high performance micro controllers are increasing the potential of UAVs. Decreased size and increased computational ability allows better estimation and better attitude solution, at a lower cost. However, with the use of MEMS sensors comes the disadvantage of less accurate measurements and consequently navigational resolution relative to time and distance.

2. MEMS measurements

Determination of flight attitude involves the computation of aircraft pitch angle, roll angle, and yaw angle. Accelerometers and rate gyros mounted into aircraft sense aircraft accelerations and body rates allowing us to compute Pitch angle and roll. The heading angle is determined by computing the magnetic heading: a magnetic sensor (magnetometer) measures the magnetic field, and corrects for the magnetic declination. With the measured three axes acceleration signals and pitch, roll, and yaw rate information —the pitch and roll angles can be determined either by computing the gravitational acceleration components on the body axes, or by using the Euler quaternion method. Computation of the gravitational acceleration components provides long-term accuracy, although it is accompanied by high noise contents. The quaternion method, however, provides low noise contents and fast response to changes in the input signals, but tends to drift with time due to gyro bias errors.

The pitch angle of the aircraft is θ, roll angle is ϕ, and the gravitational force components along the body axes (X-, Y-, and Z-axis) are g_x, g_y and g_z respectively. The relationship between the gravitational acceleration components and the attitude angle are:

$$\begin{bmatrix} g_x \\ g_y \\ g_z \end{bmatrix} = \begin{bmatrix} -g\sin\theta \\ g\sin\phi\cos\theta \\ g\cos\phi\cos\theta \end{bmatrix} \tag{1}$$

Knowing g_x, g_y and g_z, the roll angle ϕ and pitch angle θ can be computed from:

$$\begin{aligned} \phi &= \tan^{-1}\left(\frac{g_y}{g_z}\right) \\ \theta &= \tan^{-1}\left(\frac{-g_x\cos\phi}{g_z}\right) \end{aligned} \tag{2}$$

The advantage of this method is that no integral operation is involved in the computation. It is avoided divergence in attitude computation. It therefore provides the results with long-term accuracy. However, due to the nature of the MEMS accelerometers the results usually lead to high noise contents.

For magnetic heading computation, assume that the components of the Earth's magnetic field along the X-, Y-, and Z-axis are H_x, H_y and H_z, respectively. Furthermore, the resolved components in the horizontal plane along the heading axis H_1 and at right angles to the heading axis H_2 are:

$$\begin{aligned} H_1 &= H_x\cos\theta + H_y\sin\phi\sin\theta + H_z\cos\phi\sin\theta \\ H_2 &= H_y\cos\phi + H_2\sin\phi \end{aligned} \tag{3}$$

Thus, the magnetic heading of the aircraft is:

$$\psi_M = \tan^{-1}\frac{H_2}{H_1} \tag{4}$$

The body information p,q,r - the pitch rate, roll rate, and yaw rate, respectively directly measured from rate gyros. Easily with integral operations, absolute angles are realised.

However, when MEMS gyros are used for body rate measurement, long-term drift is usually encountered due to gyro bias errors and integral operation.

The modern MEMS sensors supports high sample rates (up to 200Hz) and therefore LP (Low Pass) filters are used for raw measurements. Note that LP filtering is not covered in this paper but they are integrated in the experiments.

3. Discrete Kalman Filter Design

The 'Kalman Filter' addresses the general problem of trying to estimate the state H_x, H_y of a discrete-time controlled process that is governed by the linear stochastic difference equation.

$$x_k = Ax_{x-1} + Bu_k + w_{k-1} \tag{5}$$

With a measurement $z \in R^m$ that is:

$$z_k = Hx_k + v_k \tag{6}$$

The variables w_k and v_k represent the process and measurement noise respectively. They are assumed to be independent of each other, white, and with normal probability distributions

$$p(w) \sim N(0, Q) \tag{7}$$

$$p(v) \sim N(0, R) \tag{8}$$

Q is the process noise covariance and R is the measurement noise covariance. Equation 5 is similar to the standard state differential equation

$$\dot{x} = A_x + B_u \tag{9}$$

Where $\dot{x}_u$ the state vector and u is the input or driving function, the only difference being that equation 5 is a system whose state vector is sampled for discrete time state, whereas equation 5 is sampled for continuous time state.

The n × n matrix A in the difference equation 5, relates the state at the previous time step k-1 to the state at the current time step k, in the absence of a driving function or a process noise. The n × 1 matrix B relates the optional control input $u \in R^n$ to the state x. The m × n matrix H in equation 6 relates the state x_k to the measurement z_k

An initial estimate of the process at some point t_k is assumed, and this estimate is based on our knowledge of the process prior to t_k .Let this a priori estimate be denoted by $\hat{x}_k^-$, where the "hat" denotes estimate, and the "super minus" reminds us that this is the best estimate we have prior to assimilating the measurement at t_k . Assuming that the error covariance matrix associated with $\hat{x}_k^-$ is also known, then the estimation error is defined as:

$$\hat{e}_k^- = x_x - \hat{x}_k^- \tag{10}$$

The associated covariance matrix is:

$$P_k^- = E\left[e_k^- e_k^{-T}\right] = E\left[(x_x - \hat{x}^-)(x_k - \hat{x}^-)^{-T}\right] \tag{11}$$

Since we have assumed a prior estimate $\hat{x}_k^-$, we use z_k to improve the prior estimate, by the following equation.

$$\hat{x}_k = \hat{x}_k^- + K_k(z_k - H_k\hat{x}_k^-) \tag{12}$$

Where $\hat{x}_k$ is the updates estimate and K_k is the blending factor or 'Kalman' gain that minimizes the a posteriori error covariance equation 9.

$$P_k = E\left[e_k e_k^T\right] = E\left[(x_k - \hat{x})(x_k - \hat{x})^T\right] = (I - K_k H_k)P_k^- \tag{13}$$

The 'Kalman' gain, which minimizes the mean-square estimation error, is given by:

$$K_k = P_k^- H_k^T (H_K P_k^T + R_k)^{-1} \tag{14}$$

Then estimating the next step measurement $\hat{x}_{k+1}^-$, the error covariance $\hat{P}_{k+1}^-$ and repeat the process (figure 1)

$$\hat{x}_{k+1}^- = A_k\hat{x}_k + B_k u_k \tag{16}$$

$$\hat{P}_{k+1}^- = A_k P_k A_k^T + Q_k \tag{17}$$

The contribution of w_k is ignored because it is a zero mean function and not correlated with the earlier angles.

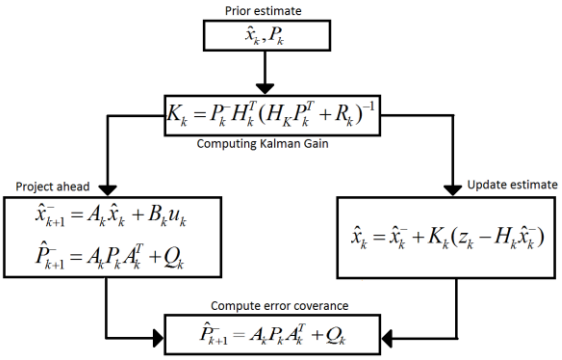

Fig. 1. The "Kalman loop"

4. Technical implementation

For the practical implementation of the Kalman filter, we are using the following hardware configuration:

- MCU (Microcontroller Unit) platform: TI (Texas Instruments) MSP430F5529, configured in Texas Instruments Lunch Pad starter kit;
- IMU gyro and MEMS accelerometers: Ivensense MPU9255;
- 2 GB (Giga Bytes) SD (Solid State) card recorder;

and the following software tools:

- TI Code Composer Studio ver.6.0 (free license);
- FatFs - Generic FAT File System Module.

The measurements and the filtering models implemented in the experiment are shown in Figure 2.

A dimensional tilt sensor uses a dual axis accelerometer and single axis angular rate gyro. The two sensors are fused via a two state Kalman filter, with one state being the angle and the other state being the gyro bias. Gyro bias is automatically tracked by the filter.

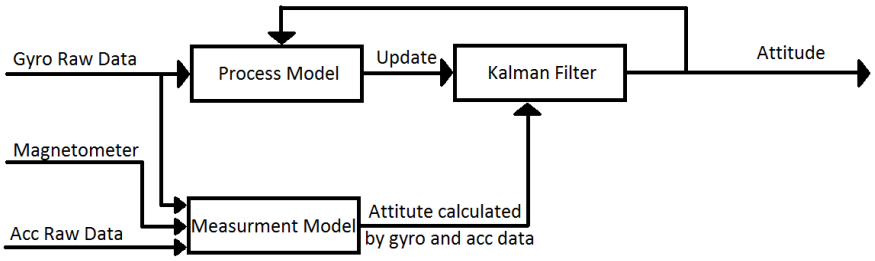

Fig. 2. Measurement and the„Kalman" filtering model

The two states are the angle and the gyro bias (q_{bias}). As a byproduct of computing the angle, we also have an unbiased angular rate available.

These are two main steps – State update and "Kalman" Update. The state update is used every dt with a biased gyro measurement by the user of the module. It updates the current angle and rate estimate. The pitch gyro measurement should be scaled into real units, but does not need any bias removal. The filter will track the bias.

The "kalman" update could be used when a new accelerometer measurement is available. The variable ax_m and az_m do not need to be scaled into actual units, but must be zeroed and have the same scale.

The covariance matrix P is updated at every time step (*dt*) and it is determined how well the sensors are tracking the actual state. The initial state of covariance matrix is:

$$P = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \tag{17}$$

The measurement covariance noise is represented by matrix R. The process covariance noise is represented by 2x2 matrix Q. In this case, it indicates how much we trust the acceleromter relative to the gyros.

$$Q = \begin{bmatrix} Q_{angle} & 0 \\ 0 & Q_{gyro} \end{bmatrix} \tag{19}$$

The state vector is X = [angle, $gyro_{bias}$]. The state estimation forward is:

$$\dot{X} = [\ \dot{angle}, \dot{gyro}_{bias}\ ] \tag{22}$$

$$\dot{angle} = \text{gyro} - gyro_{bias}$$

$$\dot{gyro}_{bias} = 0$$

The covariance matrix P is updated by the next expressions. In the beginning, it is computed the derivative of the covariance matrix:

$$\dot{P} = A*P + P*A' + Q \tag{25}$$

The Jacobian matrix A calculated of $\dot{X}$ with respect to the state vector X:

$$A = \begin{bmatrix} \frac{d(\dot{angle})}{d(angle)} & \frac{d(\dot{angle})}{d(gyro_{bias})} \\ \frac{d(\dot{gyro}_{bias})}{d(angle)} & \frac{d(\dot{gyro}_{bias})}{d(gyro_{bias})} \end{bmatrix} = \begin{bmatrix} 0 & -1 \\ 0 & 0 \end{bmatrix} \quad (26)$$

Then it is computed the expansion of $A = \begin{bmatrix} 0 & -1 \\ 0 & 0 \end{bmatrix}$ multiplied by P and P multiplied by $A' = \begin{bmatrix} 0 & 0 \\ -1 & 0 \end{bmatrix}$. This is then added to the diagonal elements of the process covariance noise matrix Q, which are Q_{angle} and Q_{gyro}.

$$\dot{P}_0 = Q_{angle} - P_{01} - P_{10} ; \dot{P}_1 = - P_{11} ; \dot{P}_2 = - P_{11} ; \dot{P}_3 = Q_{gyro} \quad (27)$$

After then it is store our unbias gyro estimate (q_m is the pitch gyro measurment.):

$$\text{rate} = q = q_m - q_{bias} \quad (28)$$

The updated angle estimate and covariance matrix P:

$$\text{angle} = \text{angle} + \dot{angle} * dt, \qquad \dot{angle} = \text{gyro} - gyro_{bias} = q \quad (29)$$

$$P = \begin{bmatrix} \dot{P}_0 * dt & \dot{P}_1 * dt \\ \dot{P}_2 * dt & \dot{P}_3 * dt \end{bmatrix} \quad (30)$$

For a two-axis accelerometer mounted perpendicular to the rotation axis, it can compute the angle for the full 360 degree rotation with no linearization errors by using the arctangent of the two readings.

The C matrix is a [1×2] (measurements x states) matrix that is the Jacobian matrix of the measurement value $angle_m$ with respect to the states vector X [angle, $gyro_{bias}$]. In this case, C is:

$$C = [\frac{d(angle_m)}{d(angle)}, \frac{d(angle_m)}{d(gyro_{bias})}] = [1 0] \quad (31)$$

Because the angle measurement $- angle_m$ directly corresponds to the angle estimate and the angle measurement $- angle_m$ has no relation to the $gyro_{bias}$.

In the "Kalman" update it is computed measured angle $angle_m$ = arkustangens (ax_m/az_m) and the error in its estimate $angle_{err} = angle_m$ - angle.

The first element of the Jacobian matrix of the measurement value $angle_m - C_0 = \frac{d(angle_m)}{d(angle)} = 1$, shows how the state measurement directly relates to the state estimate. The second element $C_1 = \frac{d(angle_m)}{d(gyro_{bias})} = 0$, shows that the state measurement - $angle_m$ does not relate to the gyro bias estimate. Then the error estimate (E) :

$$E = C P C' + R: \quad (32)$$

$$E_{[1\times1]} = C_{[1\times2]} P_{[2\times2]} C'_{[2\times1]} + R_{[1\times1]} \quad (33)$$

$$PC_{t[2\times1]} = P_{[2\times2]} * C'_{[2\times1]} \quad (34)$$

$$PC_{t0} = C_0 * P_{00} \quad (35)$$

$$PC_{t1} = C_0 * P_{10} \quad (35)$$

$$E = C_0 * PC_{t0} + R_{angle} \quad (37)$$

The next step is computed the Kalman filter gains.

$$K = P\ C'\ inv(E) \tag{38}$$

$$K_{[2\times1]} = P_{[2\times2]}\ C'_{[2\times1]}\ inv(E)_{[1\times1]} \tag{39}$$

For Kalman filter gains it is obtained:

$$K_0 = \frac{PC_{t0}}{E} \tag{40}$$

$$K_1 = \frac{PC_{t1}}{E} \tag{41}$$

The updated covariance matrix:

$$P = P - K\ C\ P \tag{30}$$

$$P_{[2\times2]} = P_{[2\times2]} - K_{[2\times1]}\ C_{[1\times2]}\ P_{[2\times2]} \tag{42}$$

It is computed $t_{[1\times2]} = C\ P$. Note that:

$$t_0 = C_{00} * P_{00} = PC_{t0} \tag{43}$$

$$t_1 = C_0 * P_{01} \tag{44}$$

$$P_{00} = P_{00} - K_0 * t_0 \tag{44}$$

$$P_{01} = P_{01} - K_0 * t_1 \tag{45}$$

$$P_{10} = P_{10} - K_1 * t_0 \tag{46}$$

$$P_{11} = P_{11} - K_1 * t_1 \tag{47}$$

Finally it is updated state estimate:

$$X = X + K * Err \tag{48}$$

$$X_{[1\times2]} = X_{[1\times2]} + K_{[2\times1]} * Err_{[1\times1]} \tag{49}$$

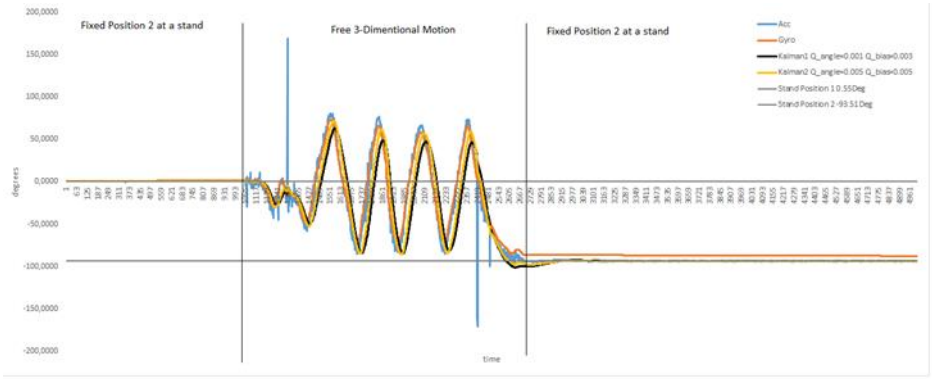

Fig. 3. Angles results

The *"Err"* is a measurement of the difference in the measured state and the estimate state. In this case, it is just the difference between the two accelerometer measured angle and estimated angle.

$$angle_m = \text{atang}\ (ax_m/az_m) \tag{50}$$

$$angle_{err} = angle_m - \text{angle} \tag{51}$$

$$\text{angle} = \text{angle} + K_0 * angle_{err} \quad (52)$$

$$q_{bias} = q_{bias} + K_1 * angle_{err} \quad (53)$$

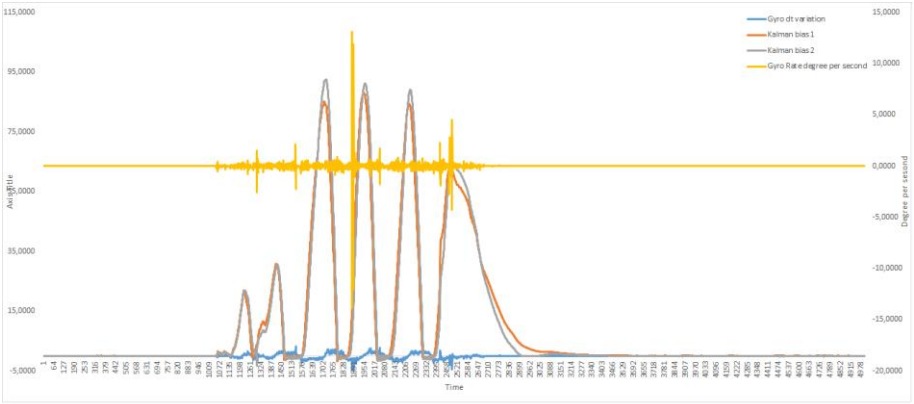

Fig. 4. Calculated gyro biases and gyro rate received by the IMU

5. Conclusion

The attitude computed from the gravitational force components provides long-term accuracy with high noise contents. The Euler angles measurements by the gyro, however, provides less noisy results but suffers from a long-term drift problem. Either method alone may be inadequate for attitude computation. Thus, 'Discrete Kalman Filtering', can be implemented to integrate the attitude computation from the gravitational force components and from the Euler angles.

The Kalman Filter is a set of mathematical equation that implement as simply recursive data processing algorithm. The recursive data process mean the 'Kalman Filter' does not require all previous data to be stored and reprocessed very time a new measurement is taken. The process have two types estimator predictor - corrected that is optimal in sense that minimizes the estimated error covariance process. Additionally, there are two types of system - one is the linear system the other is a nonlinear system. The proposed algorithm is successfully demonstrated through a set of test, data collected from the in house-designed MEMS based attitude determination system.

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Total Hazard and Risk Assessment for RPAS Technology

Stefan Hristozov

ISER-BAS, Sofia, Bulgaria
stefan.hristozov@gmail.com

Abstract. In traditional systems for reliability assessment of complex systems a task for defining safety indicators, in case certain functional failures occur leading to accident or incident. For relatively recent participant in airspace like RPAS events like that are hardly to be analyzed using theoretical reliability methods due to lack of investigation data. Using event sequence diagrams (ESD) and fault tree analysis (FTA) is presented an algorithm for unfolding investigation of an event. Such methodology is accepted and by the Swiss Aviation Authority – FOCA and could be of great aid to both other National Aviation Authorities and Insurance Inspectors.

Keywords. FTA, ESD, RPAS, UAV, risk assessment, aviation

1. Introduction

In traditional systems for reliability assessment of complex systems a task for defining safety indicators, in case certain functional failures occur leading to accident or incident. For relatively recent participant in airspace like RPAS events like that are hardly to be analyzed using theoretical reliability methods due to lack of investigation data. Due to that it is hardly to implement traditional reliability analysis methods. Using event sequence diagrams (ESD) and fault tree analysis (FTA) is presented an algorithm for unfolding investigation of an event. This allows representing of all cases considering RPAS are system of systems and participants in air traffic. Such methodology is accepted and by the Swiss Aviation Authority – FOCA and could be of great aid to both other National Aviation Authorities and Insurance Inspectors.

2. Background and explanations on ESDs

2.1. The representation of accident scenarios

Investigating aviation incidents due to technical reasons revealed, that events have occurred evaluated as practically impossible, because of not taking into consideration factors impacting on the reliability of the system. Knowledge of the influence of different assumptions on the reliability will allow concentration of the effort during testing and analysis of exploitation data. This will define more specific assumptions on the next iteration of testing. To aid in the modelling effort a systematic way of representing accident scenarios is needed [7]. The core of a model based on accident scenarios is formed by events that may lead to accidents if safety barriers are breached. Because these events may lead to accidents they can be described as hazards. These hazards themselves occur due to sequences of events starting at a particular root cause. A particular hazard can be caused by multiple root causes, and the hazard can evolve in several types of accident. This is often represented by a bow tie, see Figure 1 [4, 5, 6].

After defining safety issue the analyst has to develop respective scenario/s for the probable outcome – aviation accident. Risk is assessed afterwards for every of these scenarios

using this model. As a rule, the highest calculated risk value is considered as the meaning of the risk for the safety issue. To represent the total aviation system multiple bow-ties are needed to capture all hazards that can lead to accidents. The failure of safety barriers after a hazard takes place also has root causes. These root causes also need to be represented in the model. For the purpose of ASCOS (The European Commission (EC) Project "Aviation Safety and Certification of new Operations and Systems – ASCOS") the accident scenarios are represented using ESDs and fault trees.

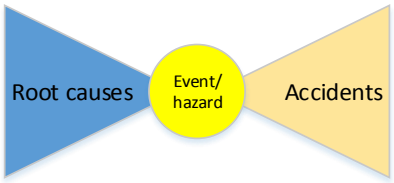

Fig. 1. Bow tie

An ESD consists of an initiating event, pivotal events and end states. A representation of a generic ESD is given in Figure 2. ESDs provide a qualitative description of series of events leading to accidents. Because pivotal events can also cause avoidance of an accident, an ESD also models scenarios which lead to incidents and reportable occurrences. An initiating event represents the start of the main accident scenario. The initiating event of course also may have causes, and they are represented in a fault tree. Each pivotal event represents a possibility for the safety occurrence to develop into an accident, or a possibility that the accident is avoided. If all pivotal events contribute towards an unwanted outcome, then the end state is an accident or serious incident. If a pivotal event causes avoidance of an accident the end state is a safe continuation of the flight. A single ESD therefore can represent more than one accident scenario, and also represents accident avoidance scenarios. In case of the generic ESD of there are 2 accident scenarios and 2 accident avoidance scenarios, see the red (accident) and green (accident avoidance) lines in Figure 2 [1, 2, 3].

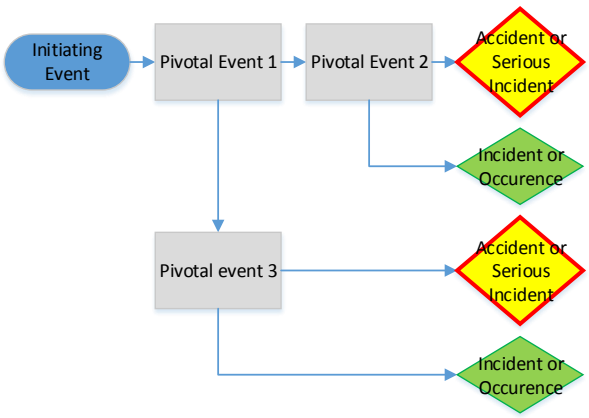

Fig. 6 Generic representation of an ESD

After defining functional failures and hazards object of the analysis the reasons for them on physical level should be found. They are combination of several different failures investigating of which is performed via FTA or Reliability Block Diagram. An ESD with its associated fault trees can be seen as a combination of bow ties. This is visualized in Figure 3 [7]Fig. 3. . Each fault tree can be seen as the left side of a bow tie, while the combination of

pivotal events can be seen as the right side of a bow tie. Multiple ESDs are needed to represent the total aviation system.

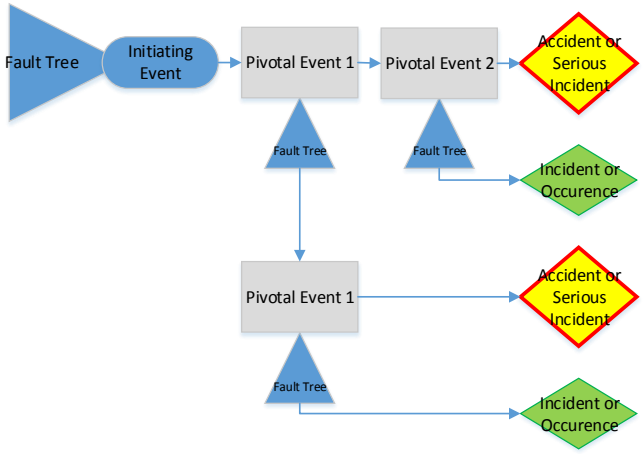

Fig. 3. ESD bow tie

2.2. The Fault Tree Analysis

Fault trees are used to represent the root causes of both the initiating event and the pivotal events of an ESD. A generic fault tree is given in Figure 4. Fault trees connect to the events in the ESDs: the top-event of the fault tree corresponds to the initiating or pivotal event in the ESD. The fault tree either shows failure propagation towards the top-event, or provides a specification of the top-event. A fault tree event is defined such that it is a "fault" or "failure condition", not a "positive" event. It is unambiguously and clearly defined, generic (e.g. not based on a specific historic incident or accident), measurable and quantifiable. Each fault tree contains events that are stated as faults and are combined by logic gates [1, 2, 3].

For the purpose of this paper, however, only two gates (AND and OR) should be used, unless a different type of gate can be shown to be absolutely necessary.

AND-gate	a certain event occurs if the underlying events occur simultaneously
OR-gate	a certain event occurs if at least one of multiple underlying events occur

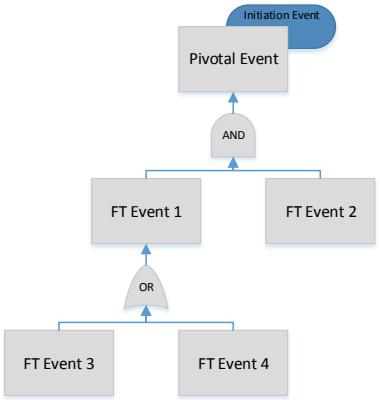

Fig. 4. Generic representation of a fault tree

3. Total Hazard and Risk Assessment

Unaccepted exploitation condition is defined as state for development of aviation accident scenario (or incident) as an outcome of the situation. That scenario could be developed as far so aviation accident can be hindered only by new effective pivotal event (safety net). Such example can be fire aboard of RPA. In that case safety net can be the initiation of Fire Warning Systems with the proper crew action [8].

The starting point for the Total Hazard and Risk Assessment [9, 10] should be any failure/abnormality in the Normal Operation Strategy and should consider as a minimum:

1) Failure of the Flight Control System
2) Failure in the Air Data System
3) Failure in the Directional Control System
4) Failure in the Propulsion
5) Failure in the Load Limiting Systems
6) Failure in the Performance
7) Unapproved Environmental Conditions
8) Failure in the Command and Control Datalink
9) Failure in the Structural Integrity
10) Failure in the Electrical Energy System
11) Fire
12) Disoriented Crew
13) Failure in the ATC Communication
14) Incorrect ATC Commands
15) Failure of other safety barriers according Part B, chapter 3.
16) Others....

These events should be used to enter the appropriate ESD type and to ultimately define the safety barriers.

3.1. Event Sequence Diagrams

As already mentioned in the Introduction, it is necessary to ensure that the ESDs are sufficiently complete. This means that all initiating events are envisaged, all pivotal events are recognized, no safety barrier is forgotten and no base event in the fault trees is overlooked. This can be done in two steps:

Step 1: Using safety assessments and product description and operational documentation for identification of all safety barriers implemented in the design and ensuring that all these safety barriers are considered in the ESDs.

Step 2: Reviewing the ESDs with experienced people having different points of view. For BLOS and operations directly over gatherings a Functional Hazard Assessment shall be provided identifying the top-level RPAS failure conditions. For all other operations engineering judgment should be used to evaluate completeness. The events diagrams shall correctly describe the various sequences and shall be aligned with the operation and system descriptions provided in the previous chapters. All safety barriers shall be identified.

3.2. Typical Failures Diagram

The diagram shows the typical failures and their propagation, which should be analyzed by the Total Hazard and Risk Assessment. Each typical failure is related to one or more ESD's as listed left of the failure (e.g. a failure in the Air Data System needs to be analyzed and the fault trees developed related to ESD1 (System Failure) and ESD5 (collision course).

The boxes in amber represent the respective requirement in CS-LURS (Certification Specification for Light Unmanned Rotorcraft Systems is a document of JARUS (Joint Authorities for Rulemaking of Unmanned Systems)), which would be a safety barrier in a certified RPAS (the same applies to the ESD2 with references to CS-LURS). Within this OM it is not required to the applicant to have an RPAS certified according CS-LURS or CS-LUAS (Certification Specification for Light Unmanned Aircraft Systems). These safety barriers can be technical, procedural, limitations or training.

3.3. ESD Diagrams

Each typical failure, having ESD1 should be considered as a separate input as a System Failure, which means, we will have several ESD1, e.g. For the GPS, for the autopilot, for the Airdata etc. For each rectangular box in each ESD, the applicant should develop a fault tree, how a failure can propagate to a catastrophic or hazardous event, or be prevented.

3.4. Typical Failures

Typical failures are presented in the Figure 5 below. In red are presented the safety nets of the system. Emergency recovery capability means we need a duplicate parallel system working in stand-by and triggering in case of an event.

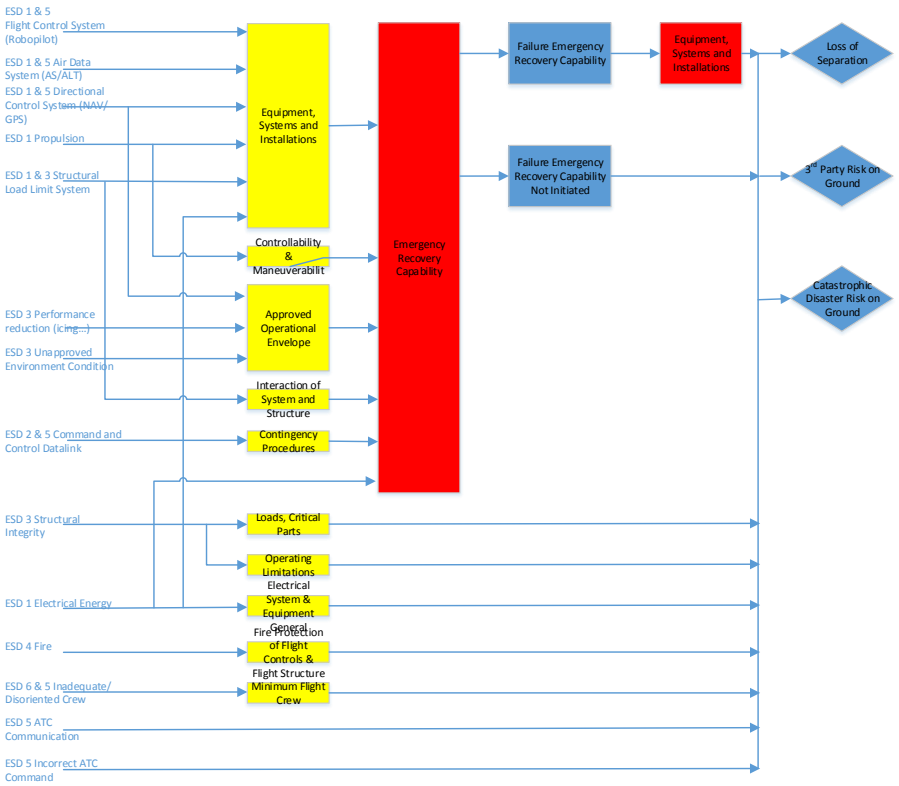

Fig. 5. Example of typical failures

4. Conclusion

In common case, the application field of the reliability theory doesn't allow specific evaluation of the level of system safety. As far as reliability theory is concerned it is important to "postpone" in time the moment of disaster. Main task of the safety system theory is to predict crashes. In Risk Management in rare cases with low possibility of occurring or of systems currently developing and no previous data is available would not be applicable to equalize risk with probability of event, we need, however, a way to investigate all probabilities.

Despite the high level of automation and complexity of RPAS it is observable the last safety net is human intervention. Additional understanding and good practices could be introduced from aviation system to reduce the risk of accident involving RPAS. Continuing of this research using JARUS and military certification documentation would be of use to both Authority and Insurance Inspectors. The goal of current paper is to outline an investigation and certification method for use in the authorities.

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Cyber Security and Contemporary World

Noncho Dimitrov

UNWE, Sofia, Bulgaria
ndimitrov@e-dnrs.org

Abstract. The object of this article is the cyber security in the modern contemporary communications. The attention is focused on the internet spy as the modern threat for the cyber security. The main object is the modern communications and the preconditions for the threats of information security to be analyzed. The activities of the National Security Agency (NSA) and terrorist organizations have a particularly important meaning for detections of the internet spying..

Keywords. Cyber security, Internet spying, Internet technology, National Security Agency, Terrorist organizations.

1. Introduction

In 21 century we have the opportunity to live in a dynamic and quick-developing environment where the scientific discoveries and information technologies are improving all the time. And this improvement changes our lives constantly. Every each area of our live is affected by the Era of Globalization. In present days, in the communication between people, institutions and countries there barely has any barriers and limits - the contemporary communications are one of the most dynamic and fast-growing sectors which reaches new picks every single day.

Thanks to the new technologies, exchanging of information is easier than ever. Only a few years ago the smartphone, the tablet and the computer have looked like science fictions. But today they let us to be part of this global net of communications no matter in which part of the world we are. Furthermore, they became an invariable part of our daily routine and we can`t live without them anymore. But this development of the new technologies doesn`t stop with the modern hardware. Every single day the social medias in Internet becomes more and more popular. Until few years ago, it was considered that the e-mails and mobile phones are the pick of the communications. But today the social medias removed these traditional forms of communication and became the main tool for exchanging of information. The business with virtual networks is evaluated on a million dollars and the sector is improving so dynamic and fast that we can track the changes nearly for hours.

2. New challenges for the cyber security:

The fast-growing sector of the global communications attracts thousands of new users and investors every single day. However, until few years ago, nobody was thinking about the risks and threats hidden in it.

The cyber security is the stability of the information systems. It represents a security of danger and damages caused by fault, rejection or misuse. Today there is no system which is completely protected of attacks that why is so important to increase the ability of systems to minimize the damages of the attacks and to be recovered as quickly as possible.

In present days, the systems of communications and Internet are such unsafe environment so the users can`t be completely sure that their actions are not watched and recorded by someone in every single moment.

About 150 000 viruses and about 148 000 computers are compromised every day. According Symantec, the victims of cybercrimes globally loses about 290 billion euro per year and according MsAfee the revenues of cybercrimes amount to about 750 billion euro. Exactly these monetary losses are one of the main problems connected with the cyber security.

3. Risks and threats in the contemporary communications:

computer viruses - in computer jargon," virus" means self-expanding program which spreads by inserting copies of itself into another executable code(programs) or documents. That`s where the name of those kind of programs comes - their behavior is similar to that of a biological virus that multiplies by inserting itself into another living cells. By analogy this process is often called "infection".

Social engineering - in the context of the information security, social engineering means psychological manipulation which has for a purpose to extracted necessary information or to urge people to make certain activity.

Internet spy - this term gained a big popularity last year. It explains a set of actions targeted gathering information for certain individuals and organizations. These actions includes: eavesdropping on phone calls, tracking IP addresses, an e-mail infiltrations and tracking an internet correspondences.

Hacker attacks - these are the most famous and the oldest threats for the security. Hacker attack is purposeful action of penetration and access to information and also about controlling of different sites, in purpose to sabotage the work of the institutions and the organizations who owns them. The hacker's uses different methods include computer viruses, social engineering, spy and etc.

4. National Security Agency (NSA):

One of the biggest international scandals for 2013 shacked the global communications. Disclosure of multiple secret documents from the former Central Intelligence Agency (CIA) employee - Edward Snowden, has hit hard on the contemporary ways of data transfer. The secret information that lacked in the world medias literally shocked the world. It makes clear that CIA uses ruthless methods to gathering information which really often exceed the powers of the relevant service. A number of world leaders and meetings in high level from European Union were eavesdropped. These facts significantly tightened the relations between EU and USA.

The evidences for spying of political leaders were just one little part of the big spy scandal. The most disturbing were the revelations about the access that CIA has to the servers of 9 of the biggest companies in the world - Google, Microsoft, Facebook, Yahoo!, Apple and others. This, in turn, created a new and unexpected threat. Before Snow Eden's revelations a very few people realized that the cyber space is watched environment.

For the last years NSA was one of the most discussed themes in the world media space. You can find information for the agency easy and they also have an official website. According the information in it, NSA is a home of the American cryptographers and code breakers. The agency has provided timely information to the US government and the military for more than 50 years. Central Security Service (CSS) part of NSA, was founded in 1972 to provide a reliable partnership between NSA and the crypto logical services of the military.

NSA is the most unique security agency in USA because of here broad powers. The agency provides important tactical and strategic information to Department of Security, to other government agencies, to intelligence services and industrial partners which are needed to draw up military plans and strategies.

NSA has a key role in the US intelligence and the confidentiality in her structures is in a higher level. The agency's activities are generally combined in 3 areas: Information security - aimed at preventing the access of foreign intelligence services and protecting of classified US information; Signals intelligence - for gathering and information processing for the Secret services and military missions and Combat network specialized in the fight with terrorists and terrorist organizations.

The mission of the agency is to ensure the US government the sphere of cryptography by provides products and services by the sphere of Information security and Signals intelligence. NSA also provides using the systems of managing networks to obtain the ultimate superiority of the Nation and allies in every circumstance.

According other sources, NSA is one of the biggest Intelligence agencies in USA in terms of staff and budget. It operates under the jurisdiction of the Department of Defense and it reported to the director of the CIA. NSA is doing a global monitoring, gathering and processing of information about foreign intelligences including purposefully surveillance of individuals of the territory of the USA. The agency is authorized to fulfil your own mission in every possible way even with illegal resources like bugs on electronic systems and sabotages of different soft wares. NSA also maintains the security of the government communications and information systems. According many people the agency gathers and stores all phone calls of the all American citizens as a part of the expanding monitoring practice for mass surveillance.

5. Internet spy and terrorist organizations:

We are encouraged to search in the Web, to share our lives with friends and to take advantages of any free services. In return, the internet titans which provides these services like Facebook, Google and many others, not so familiar companies, thoroughly tracking every single our move to flood us with target ads.

The users, who not so long ago rejected the problems with protection of the personal data, feel more and more that they are lost the control of their personal information.

Meanwhile, the Internet companies, the advertising technology companies and the data brokers continues to introduce new technologies to make even more detailed hundreds of millions of profiles even a billions of users.

For the last few years a big problem for the society is that, although the whole precautions that the internet giants take, the cases to the internet spying are increasing. More and more is talked about draining of personal data of users. These data is using for muses or tracking the personal lives of the users. The drained personal data also can be used by terrorists.

The evidence of this problem is numerous opinions that ISIS can bring the battel in the cyber space. In this way ISIS will win much more advantages in this asymmetric war. The limits for entering in this cyber war are remarkably low even for non-state actors. Even that ISIS can`t make any cyber-attacks in the moment, it`s unlikely that it can encounter any difficulties in recruiting followers with the necessary expertise. In the past, other terrorist and rebel organizations including Al-Qaeda, have achieved that. The experts warn that ISIS could hit unprotected infrastructure or private residences. Hundreds of thousands of industrial and commercial control systems including fast-growing "the Internet of Things", create wider gaps in the daily routine which is vulnerable to breakthrough. Even more worrying is warning from Nuclear Threat Initiative, a non-governmental organization, which is devoted to strengthening

of the global security, that many public and military nuclear facilities has an inadequately protection against cyber war.

6. Methods and tools for cyber spy:

There are many facts and arguments that many European statements has been spied for years and also that there has been an access to data of millions of nothing suspicious users of Internet and social medias all over the world.

Internet spy is possible by penetration of major communication links which connected separated centers of Google and Yahoo! in the world. Thill allows gathering of an information and profile content from the profiles of millions of users of the both e-giants.

The information is essential goods and the procedures for database backup which every company strictly follows, means that the information is duplicated in servers in the entire world. In simple terms, if somebody send an e-mail to address in the USA it doesn`t particularly mean it will stays in the territory of the country during the whole it`s life in the "cloud".

The program PRISM provides access huge amount of information from nine technological giants among which are also Google and Yahoo!

Measures of the Internet companies to restrict Internet spy:

Google, Facebook and Yahoo! are looking for new ways for fighting with the Internet spy by using difficult to hack code which one the use to protect their nets and the user's data from spy. The companies are sure that they must give to their user as secure as possible online connections and protection against data theft.

The Internet companies, including Google, Yahoo!, Facebook, Microsoft and Apple are trying to distance themselves from the information that there is a crack in the system. While the firms are fighting to prevent every try of the hackers to receive unlimited access their database, meanwhile the terrorist organizations realized more and more known cases of draining personal data.

The companies are fighting with this by using increasingly complex encryption of the information which encrypts the data by using a mathematical formula which can be decoded only with a special cipher key.

Google is making more and more efforts to encrypt the information that`s running between its data centers. Furthermore, it increases twice the length of your keys and enforcing strengthens measures to recognize deceptive certificates to check the authenticity of the websites.

7. Conclusions

With the progress of the contemporary communication, the ordinary users are feeling much more in secured and threatened by using the services on world companies from the IT sector.

There are undisputable facts that the internet spy is mainly done by one of the biggest state institutions - National Security Agency of the USA and by different terrorist organizations which are threatening the national and the world security.

Considering the technologies that we use today, the limit between legal and illegal resources for gathering of information is becoming increasingly unclear and easier to pass.

8. Finale

An undeniable fact is the existence of unauthorized using of database from the cyber space. Here is the question: To what extent the IT companies participate voluntarily in the spy of their clients? We must take into account, that the growing uncertainty in these sphere reflects negatively also on their financial results.

We strongly hope that the IT companies have already seen the danger from the huge loses and they have already understood that the safety of their users must be huge priorities for them. The summit of the information and constant monitoring in the cyber space is damage for all of us but most of all and for the companies themselves. We expect that in the next few years the struggle against the spy and monitoring of the information technology will shifted to struggle against terrorist organizations. This is the only possible move that can make the users of information services to feel, at least in parts, protected from surveillance.

Unfortunately, in this modern contemporary world with the continuous development of technology the complete security of the users is just one big illusion.

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Nuclear Security and the Threat of Terrorism – Errors and Lessons from Nuclear Accidents

Milka Yosifova

UNWE, Sofia, Bulgaria
milkajo@abv.bg

Abstract. In recent years there has been continually return to the rhetoric of the three major nuclear accidents at Three Mile Island (USA) in 1979, Chernobyl (Ukraine) in 1986 and the Fukushima- I (Japan) in 2011. The security and safety of nuclear energy always comes first as risky technology because it cause harm to hundreds of thousands of people, contaminate the land for decades, the watersheds and the trees and leave behind dead areas on the map of the globe. The debate on nuclear energy development has always been controversial. Following the accident in Fukushima number of countries declared that will close their nuclear power plants by 2020- 2030. Over time, less and less are the evidences about enforcing these intentions, unlike the threat of nuclear terrorism.

Keywords. Nuclear security, Safety, Emergency, Nuclear terrorism, Kozloduy NPP.

1. From the atom to the nuclear energy

In 1911 the first theoretical model of the atom was developed by Ernest Rutherford. Number of physicists, such as Niels Bohr, Henri Becquerel and Marie Curie, put the foundations of the division of the nucleus, and in 1932 James Chadwick discovered the neutron. In 1938, German physicists Otto Hahn and Fritz Shrasman made the first successful attempt of nuclear fission.

On December 20, 1951 in the experimental station EBR-I near Arco, Idaho was produced the first generated electricity with a capacity of 100 KV.

The world's first nuclear power plant connected to the national grid began operating on June 27, 1954 in Obninsk USSR (Russia), a city in Kaluzhskaya area, which continued its operation till April 29, 2002.

The generated by the reactor 5 megawatts of electricity were sufficient to meet the needs of 2000 households. In 1956 in England opened the first commercial nuclear power plant "Calder Hall" in Sellafield, with an initial capacity of 50 MW, and in 1957 the first nuclear power plant in the United States.

In 1957 were established Euratom and the International Atomic Energy Agency (IAEA). By 2007, there were 435 nuclear reactors operating in 31 countries worldwide. Nearly 30% of electricity in the European Union is produced by nuclear power.

The future of nuclear energy is a subject of controversy and discussions regarding the benefits of its development and on the other hand the need to close the nuclear reactors as a guarantee for the security of mankind. According to the World Nuclear Association - WNA, nuclear energy grow steadily in the US, Brazil, Argentina, South Korea, China, India, Russia, Canada, Pakistan and France. Finland is currently building new power plants and in the UK, South Africa, Poland, Romania, Turkey and the UAE the construction of new facilities are on the agenda.

Security and safety of nuclear energy always comes first with this type of technology so risky due to its possibility to cause harm to hundreds of thousands of people, pollute for decades the land, the watersheds and the trees, thus leaving behind dead areas on the globe.

Statistics recognize that nuclear energy has taken considerably less lives in accidents than any other electricity sources did such as coal, natural gas and hydroelectric power. However, in terms of financial damages it also recognizes that nearly 41% of all material damages come as a result of nuclear accidents.

According to information in the Belgium media, the director of the Belgium program for research and development in the field of nuclear energy Derniere Heure has been monitored by the terrorists who carried out the attacks in Paris in November 2015 and which killed 130 people and 350 were injured. It is assumed that an attack was planned on European nuclear power plant and possibly at the Belgium plant. In other words this means that DAESH plans to hit nuclear facilities in the European Union, which is a signal indicator that the question of national and European security is a problem not only for Europe but for the whole world.

2. Nuclear Energy

Nuclear energy is a type of energy, which covers the generation of electricity and heat from nuclear reactors. The first nuclear reactors were built after 1940. In early 1950 this type of energy went into bloom due to the economic and military-technological progress. By the mid-80s of the 20th century hundreds of nuclear reactors were built in dozens of countries around the world, and by 2012 dozens more will be under construction.

United States of America, France, South Korea, Britain, Russia, Canada and China are the largest producers of energy from nuclear power in the world. The development of nuclear energy is primarily associated with disputes over the price that continuously, about the risks and safety and the radioactive waste. The debate about the safety and security of nuclear power plants begins after the three major accidents:

Significant radioactive contamination accompanying these accidents leads to evacuations, increased cancer incidence and economic issues arising out of clearance of contaminated areas. Supporters of nuclear energy point out as major advantage the lack of a negative impact on the climate, low fuel consumption and its high performance.

Major accidents in NPPs are primarily the result of human error or a series of mistakes in the implementation, management and operation process. Accidents are followed by communication failure to timely inform the population in moments of elevated radioactivity. The authorities responsible for risk management do not learn from mistakes of previous incidents neither in terms of coordination and safety inside the plant, nor with the external communication during and after emergencies. In this regard we need a new approach in crisis situations communication or the so cold risk communication of high-risk industrial facilities, such as the nuclear power plants.

Nuclear power plants are undoubtedly the most dangerous facilities developed by humans for use in peacetime. Analysing the three largest nuclear power plant accidents in the world we can outline the conclusion that all three happen in the best technologically advanced for its time countries. There are not enough good research works and conducted "stress tests"

in crisis situations, which might occur for example if a plane with suicide bombers fly over a NPP as it happened in New York with the destruction of the Twin Towers in the United States.

After the Fukushima accident much stricter security requirements were introduced which required big unexpected investments for many reactors. Fixed parts of a reactor have life more than 60 years, but all moving parts and pipes must be changed regularly and be in an immaculate condition that requires too many financial resources.

3. The frequent accidents in the nuclear power plants- a preceding warning or a sign for a problem in the national security

3.1. Japan

When it comes to nuclear safety and dangers, Fukushima is the first association that society remembers from the recent past. At 14.46pm on March 11, 2011 a strong earthquake of magnitude 9 on the Richter scale shook the Pacific and cause the gravest disaster that Japan has experienced post-war. The tragic and devastating natural disaster was followed by the accident at Fukushima - the melting of the core of three of the six reactors, which began to leak radioactive material. Reactors 5 and 6 were promptly shut down during the accident for routine checks and were not damaged. However the cooling systems of reactors 1-4 were totally destroyed. Years had to pass from this accident for the operator of the Japanese Nuclear Plant to start discussing their decommissioning.

The consequences of the earthquake, the tsunami of 14 meters and the subsequent accident at the Japanese plant in 2011, continue affecting the country for further four years after the disaster.

Japan had 54 reactors in operation before the accident in Fukushima, covering 30% of the energy needs of the population, which have been gradually stopped, and 70% of the population is strongly against their reopening. Japan financial losses from the accidents are between 600 and 775 billion dollars.

There are no estimates how much radioactive water has leaked into the ocean. The main leaks are underground water and cracks in the reactors. Specialists consider that contaminated water is directed mainly by currents to the shores of North America and the impact on the tuna shows a content of caesium 10 times above the norm.

For years, Japan arrogantly claimed that it is not possible for an accident to occur at its Nuclear Power Plants and this way underestimated the possibility and danger of tsunami. Now 1/10 of the territory of Japan is significantly contaminated by leakage of radiation on the earth

surface layer, forest situation is hopeless and most of it should be destroyed. Only in February 2014, 26 children have been diagnosed with "thyroid cancer" but observations show that the boom of the consequences following such an accident is activated from three to five years after the accident.

Four years after the disaster corps of 2600 people, residents of the devastated northeast coast are still missing despite monthly search operation performed by police forces and soldiers.

The biggest risks are associated with the melted nuclear fuel masses which have great content of radioactive materials significantly more than those at Chernobyl, which is an ecological disaster. At the end of 2013 the radioactive water contamination at the site of NPP "Fukushima" is over 450 thousand tons. A possible solution for the crisis on site to be overcome is the installation of a new tank of 1000 tonnes every two days and a half. It is believed that frozen masses nuclear fuel will begin to be withdrawn in 2020 for a period of 30-40 years.

At the beginning of 2014 the level of radiation in the groundwater of the technical well of the first and second reactor of the Japanese nuclear power plant "Fokushima-1" reached new record levels after the accident in the spring of 2011, according to information of the operator of the plant- Tokio Electric Power. The abrupt change in the levels of beta radiation is explained by the distribution of particles in groundwater due to heavy rains brought by typhoons "Fanfon" and "Vonon." In comparison with studies in August of the previous year, the level of radiation was located below the established norm of 1 milizivert, but since then a rise began and reached a level of 7.8 miliziverta.

From the new samples taken on October 17, 2014 can be seen that the content of the isotopes of cesium-134 and cesium-137 per litre water is 267,000 Bq when the permitted level in Japan can`t exceed the maximum concentration of 30 Bq. [1]

Japan counts on Russia's help to minimize the consequences of the accident at the nuclear power plant "Fokushima-1" by applying new technology involving Russian specialists, according to Junichi Eguti, director of the centre for responding to nuclear accidents in the Department of electricity and gas in the Agency for natural resources in Tokyo during a conference on Russian nuclear technology. [2]

The cases of wrongdoings associated with this plant were not rare. Two employees of a construction company chosen as a subcontractor in the reconstruction of the plant were arrested in September 2013, when it was established that 515 kg radioactive soil was discarded in the yard of a residential home in the city of Tamura.

Japan have lost hundreds of billions of dollars since that nuclear disaster, hundred thousand people were evacuated due to high radioactive emissions and the land around Fukushima will remain uninhabitable for decades.

Japan was once again subjected to strong earthquake soon after Fukushima disaster with a magnitude of 5.9 and depth of 37 kilometres in Fakushima Prefecture, where the nuclear power plant "Fukushima Daiychi" was in operation. Its reactors caused a real danger of nuclear catastrophe that seriously worried the local population for their lives. The epicentre of the earthquake was located 49 kilometres east of Nami, on the island of Hoshnu. Before this earthquake another earthquake was registered with a magnitude of 5.4 and epicentre near the Kuril Islands. The outbreak of underground tremors was about 50 kilometres deep with an epicentre the Pacific Ocean, but tremors were felt even on the territory of the Japanese prefecture of Hokkaido which luckily this time didn't suffer any tsunami victims or damage.

Eighteen months after the consequences of the tragedy in 2011, the Japanese government plans to announce its withdrawal from producing nuclear energy by 2030. If Japan chooses to abandon nuclear energy, it will join the countries that have chosen this strategy

after Fukushima. Germany has decided to shut down its 17 reactors by 2020, while Switzerland will gradually stop its five reactors by 2034.

Japanese authorities gave the green light for reimbursement of only two reactors in central Japan. Others were suspended due to the earthquake or because they do not meet the additional security requirements requested by the authorities after Fukushima.

In August 2015 after stopping all nuclear reactors in September 2013, Japan restarts the first reactor of the plant "Sendai" which is 1100 kilometres southwest of Tokyo, in Kagoshima Prefecture. Restarting the reactor caused protests from anti-nuclear activists. In July 201 2 two blocks in NPP "Oi" resume their operation after tense negotiations between the government and the authorities of the prefecture of Fukui, but a year later they were again stopped for scheduled inspection due to strong opposition from local authorities.

Various publications after the nuclear disaster were suggesting that the state of Israel is responsible for the sabotage of the plant in an act of revenge as a result of the support Japan showed for the self-proclaimed independent Palestinian state.[3]

Former editor of the Japan Times Weekly claims that those nuclear materials were sent to the plant in 2007 on the orders of Dick Maine and George W. Bush, with the tacit approval of Israeli Prime Minister Ehud Olmert. According to unconfirmed publicly disseminated information the package was in the form of nuclear warheads, secretly removed from nuclear warheads transported from the port of Houston through Israel (In leaked by the CIA information, 20 minutes before the nuclear disaster at Fukushima plant, Israel twice try to hack the computers of the plant with the virus Stuxnet. The virus impedes braking, leading to contamination of the majority of plants and homes in the area with uranium and plutonium recovered from warheads granted in 2007. Roland Vincent Carnaby dealing with the study of warheads transported them to Houston. In a strange twist, Carnaby was mysteriously shot dead less than a year later in Houston by the police force during road block. He was shot once in the back and once in the chest. He had no weapon in his hands. Intelligence sources said that Mossad unit was traced smuggling US plutonium from the docks of Houston Israeli nuclear reactor [8].

Although it is impossible to verify some of the claims of Shimatsu mass blackout during the Fukushima disaster, it is evident that the explosions were underestimated in the beginning, with the intention the disaster to be assessed with Level 4 on the International Nuclear and Radiological scale, even though, the independent experts declared the highest level of seven for this accident. In 2009 just after two years of investigations in Shimatsu, the International Atomic Energy Agency (IAEA) issued a hidden warning to Japan to abandon its policy to use nuclear weapons. Furthermore, the IAEA warned that nuclear installations safety rules in Japan are outdated and an earthquake stronger than 7.0 on the Richter scale can cause serious consequences.

The lack of an international criminal investigation on these public statements is the clear signal that the reasons are multi-layered and the security is undervalued. After the nuclear tragedy in Chernobyl (Ukraine) in 1986, the Japanese nuclear disaster is the worst disaster that causes a crisis of the entire nuclear industry in the world.

3.2. The tragedy in Chernobyl (Ukraine) leaves implications for Europe

On April 26, 1986 the Soviet Chernobyl nuclear power plant has experienced severe industrial disaster level 7 from the International Nuclear Event Scale. Vast areas in Ukraine, Belarus and Russia are contaminated and a cloud of radioactive waste passes over Eastern Europe and Scandinavia, and even Bulgaria. Over 200 000 people were evacuated from their homes in the area.

The incident raises the question of the safety of the Soviet nuclear energy. The separation of Ukraine and Belarus from Russia increases significantly the costs for decontamination and health damages.

On the time of the incident the power plant has 4 nuclear reactors into operation from 1977 to 1983. The reactors are type RBMK – with high power channel and a graphical retarder which have a significantly higher power than equivalent reactors with aqueous retarder.

Three years ahead of the Chernobyl accident another accident happens with a reactor of similar design - first generation RBMK-1500 at Ignalina nuclear power plant in Lithuania, which accident in a way resembles the Chernobyl one. Structural defect which instead of temporarily decreasing the power of the reactor multiplies it causes very serious damage to the reactor core. Against all odds Ignalina RBMK survived. The incident at Ignalina is not taken into account for redesigning the control rods of reactors of this type in the construction of the Chernobyl reactor.

Serious analysis have been undertaken after the Chernobyl accident which concluded that the reasons are a combination of wrong actions of the responsible personnel and structural defect in the leading part of the control rods. The circulation of cooling water in the reactor was reduced, the refrigerant was heated very rapidly to the point of boiling, which forms steam pockets in the pipes, which means that the power of the reactor rise with the increasing concentration of the vapour.

An attempts by the operators of the plant have been made to control this process manually using the emergency braking. Due to the slow speed of the driving rod mechanism, the reaction in fact is accelerated, which makes the reactor power to jump to 30,000 MW in seconds which is 10 times higher than normal. With nuclear fuel rods beginning to melt, the steam pressure rapidly increased, causing a large explosion that ejected and destroyed the lid of the reactor weighing 1200 tons and thus damaging the roof.

When the air get in contact with the graphite moderator of the interior of the reactor, the graphite is ignited. Radioactive contamination comes as a result of the fire, which spread radioactive particles into the atmosphere in the form of cloud swiftly drift by the air masses.

Almost 213 people were emergently admitted to hospitals, 31 of which died of acute radiation syndrome. Most of them were firefighter rescue workers who have joined in managing the accident. More than 180,000 people were evacuated from the accident area and its neighbouring areas.

The conclusion of the nuclear experts concluded that procedural violations such as inadequate communication between operators and the employees responsible for safety or the

so called human factors have contributed to the accident. Classifying much of the information about the operation of the reactor and proclaiming the whole accident as a military secret was highlighted as another reason for the tragic consequences of the tragedy. Furthermore, in order to save money, the reactor had no further protective circuit in which the rest of the damaged reactor to prevent radioactive contamination to spread into the atmosphere.

To limit the damage from the accident and prevent a second blast with capacity over 5 megatons, which would have flooded Europe with radioactive dust, 18 billion US dollars were invested in less than six months, which is equivalent to about 50 billion US Dollars today. More than 600,000 military and citizens have worked on closing the reactor, limiting the spreading of the radioactive dust in the 30 km zone, constructing bypass walls, etc. From all the volunteers that took part in the recovery works from the accident 25 000 have died under the age of 40, while 200 000 have been declared disabled.

On December 15, 2000, at 13.17 pm the third power unit of the Chernobyl NPP was officially closed down thus finally terminating the performance life of the nuclear plant.

Many governments of different countries, including Bulgaria and France, in their attempt to deny the incident or the presence of radioactive dust into the atmosphere also contributes to the many innocent victims given as a result of this tragic incident.

Cases of leukaemia in Europe have increased 60 times in the last 20 years. Based on statistics from 1970 can be drawn a conclusion that between 0.05% and 0.1% of the population is directly affected and about 1% is indirectly affected by the accident, which numbers speaks for themselves if we just try to imagine what would have been the effect of a minor nuclear war?

In 2015 international news agencies announced that "The energy future of Europe will be the new Cold War."

3.3. Are the nuclear plants in the USA safe enough?

The accident happens at around 4am on March 28, 1979 in the second power unit, located in the city of Harrisburg, Pennsylvania, USA. Two consecutive operator errors lead to the release of large amounts of radioactive water which role is to cool down the reactor primary circuit and as a result of this leak overheating occurs and partial meltdown of the core of the reactor which leads to the release of radioactive materials in the containment zone. Equipment failure and the wrongly identified cause of the accident lead to a series of other operator errors. The alert system for the increased radioactive pollution has been activated more than 2 hours later when the hermetically closed zone of the reactor is flooded by over 120,000 litres of radioactive water. The dimensions of the disaster became clear 5 days after the accident when an official evacuation of the population in the area was declared. Outside the zone was discarded around 2 Ci iodine-131 and 480 terabekerela of radioactive gases xenon and krypton causing thyroid cancer.

Five years later in 1984 the court cases brought by victims revealed as conclusions that the authorities still have not admitted officially the truth of the incident and dozens of people have died from cancer, while others have developed anomalies entirely comparable with those caused by ionizing radiation.

As a result of the investigations which followed the accident, civil formations won a joint lawsuit against the headquarters of the nuclear plant and received 25 million US dollars as compensation by court agreement. At least 82 million publicly documented compensation were paid by Met Ed and their insurers to individuals for loss of benefits, cost of evacuation and health claims. Apart from the lawsuits, in September 1979 was held the largest demonstration involving 200,000 people in New York City. In May of the same year 65,000 people join a march against the nuclear power energy in Washington, DC.

The expenditures as a result of the accident are estimated at 3 billion dollars while over 140 000 inhabitants were affected by the accident, one died and nearly 100 people were hit by the radiation. Over the years these statistics have been constantly changing into different sources. Clearing after the accident officially ends in December 1993 and thus the accident falls within the group of the most dangerous accidents, rated fifth degree according to the international scale as "an accident with serious consequences."

In 2009, Victor Galinski of NRC shares his views "It was not until years later, when the reactor was practically open, when we got to know that nearly half the uranium fuel has already been melted at the time when the operator sends the first signal to the NRC at around 8am". [4]

The damaged second reactor of the NPP operates with the same water protection type reactors like the ones in Kozloduy and Fukushima.

On March 7, 2016 series of explosions and fire as of fireworks lit the skies over the "Okoni" NPP in the American State of Georgia. State of emergency was declared and the fire of the transformer is extinguished in 30 minutes. No casualties were reported and no danger of transmition of radioactive substances, but one of the three reactors has stopped. The accident was elevated from category *"emergency"* to *"alarm"* because the fire damaged the electric distribution station in one of the most powerful nuclear power plants in the US, which produces about 2600 megawatts of energy.

Fifty kilometres north of New York in "Indian Point" NPP in water samples were detected radioactive materials, only a month ahead of the accident at the “Okoni” nuclear power plant. Such cases became recently more frequent in this NPP. In December 2015 one of its reactors shut down automatically because of interruptions in the electricity supply. The investigation established that the reason are the bird excrements which entered into the system. The "Indian Point" NPP is the power plant in the USA where most breakdown accidents have occurred. [5] In May 2015 a transformer exploded, thus again causing panic among the local population.

3.4. Belgium

A nuclear reactor has been stopped on December 25, 2015 due to a failure. Belgian company *"Electrabel* ", part of the French group "Engie" stopped a nuclear reactor Doole 3 because of water leakage, just days after resuming its work following a two year shut down. According to the company it is still too early to say when it will restarted its operation again since the cause of the leakage is still to be established.

The 1006-megawatt reactor was restarted for work after twenty-one months break. Electrabel Company repaired seven Belgium reactor, four of which in Doel Nuclear Power Plant and three in Tianzh NNP that cover nearly 55% (6,000 MW) of electricity consumption in Belgium.[6]

Belgium plans to close all its nuclear reactors by 2025.

France and Britain have decided to launch a new generation of reactors, while China and India are planning to start the construction of dozens of reactors in the coming years. Turkey is also planning major construction of nuclear facilities and Bulgaria has so far refused the construction of new nuclear power plant.

Russia starts construction of coastal infrastructure for the first floating NPP. On October 6, 2016 in the northern Russian city of Pevek the construction of the coastal infrastructure begins for the "Academician Lomonosov" first floating nuclear power plant (FNPP) in the world, as part of the state corporation "Rosatom", which should be put into operation by 2019. It will become the most northern nuclear power plant in the world with 70 megawatts of power and will be able to desalinate seawater. For the moment Bilibinska NPP located in Chukotka is the most northern nuclear power plant which will terminate its operation in the coming years.

4. Bulgarian NPP Kozloduy ensure safety and security

The construction of Kozloduy Nuclear Power Plant began on October 14, 1969. It continues to be the only NPP in Bulgaria and whole South-eastern Europe and the largest producer of electricity in the country. Construction and operation of nuclear facilities is carried out in three stages. In the first stage in 1974 is activated the first reactor and in 1975- the second one, with an official opening held on September 4, 1974. During the second stage are built and put into operation the next two reactor blocks, the third one in 1980 and the fourth in 1982. During the third and last stage is constructed and placed fifth block in 1987 and sixth in 1991.

Decision of the Council of Ministers on December 20, 2008 declares first and second block as facilities for radioactive waste management, and on October 18, 2010 they are decommissioned. The third and fourth block were decommissioned on February 25, 2013.

The safety of Kozloduy NPP is a top priority and is subject to independent public oversight of the Nuclear Regulatory Agency in MS. The high level of safety in the Kozloduy NPP was remarked during the inspections by the International Atomic Energy Agency, the World Association of Nuclear Operators and the Group on nuclear issues in the EU. The NPP meets all environmental requirements of the Kyoto Protocol, mainly because the technology does not emit greenhouse gases into the atmosphere.

Two are the main documents demonstrating the safety levels at a nuclear plant:

- Report on safety analysis - which is the passport of a reactor and must show all aspects related with design and provision on systematically and on operational level that the plant will meet all criteria for safety ;
- The safety analysis has become standard and license requirement as a model and method which can give quantitative expression on risk .

The safety measures which are being undertaken in the nuclear power plants are aimed at reducing the possibility of accidents with severe consequences. In the early years of the nuclear industry, safety analyses did not include probabilistic estimates of hypothetical accidents. The first study was conducted by the United States and is known as Report "Rasmussen" which is the first assessment of the potential risk of damage to the core of a nuclear reactor. The safety analysis is the only way to determine the absolute value of risk and after the study conducted in 1988 it becomes an obligatory requirement for all plants in the world. The risk can be hypothetically divided into three parts:

- The first level deals with the risk assessment of the time of occurrence of the event and is the first prerequisite for any discussions on disposal of radioactive products;
- The second level is based on results from the first level and begins to examine the accident after the fuel has broken the hermetically closed construction of the reactor;
- Third level task is to analyse how and where the radioactive products will spread and thus to evaluate the consequences.

5. Nuclear security under the threat of terrorism

In January 2016 the President of the United States organize a summit on nuclear security, which was attended by world-renowned leaders. The topic is terrorism and threats to nuclear security. Easily accessible nuclear materials can be accessed and stolen and then used for the development of small nuclear devices or dirty bombs. As a big achievement at this meeting was establishing a control over exporting fuel which can be used for bombs and nuclear security was firmly placed on the agenda of the world, although some countries do not agree with the proposed guarantees.

One of those countries is Russia, which blocked the summit, and which has some of the largest stockpiles of nuclear materials for civilian use. The Pakistani nuclear policy turned toward the acquisition of new generation smaller tactical weapons which are easily and uncontrollably accessible for theft and misuse, which is of the reasons for the growth of terrorism, despite the progress of Pakistan in the field of prevention through training of guards and investments in the sector.

Pakistan, China, Japan and India are planning expansion of their sources of plutonium, which naturally will increase stockpiles of fuel for bombs.

In some EU countries, such as Belgium for example, the fast that specialists in the field of nuclear energy join the forces of the Islamic State represent a real threat for the security of the country. The term "nuclear terrorism" becomes notoriously popular. There is strong evidence that groups such as "Islamic state" are seriously interested "*more than ever in the nuclear power plants, materials and staff "[7],* which is already a serious problem for the nuclear security.

6. The European resolution regarding the lessons that need to be learned for the nuclear security in Europe

The Treaty establishing the European Atomic Energy Community and the Treaty on the Functioning of the European Union (Art. 194), The Resolution of 10 May 2007 on

Assessing Euratom-50 years of European nuclear energy resolution on the nuclear accident in Japan, Chernobyl and the US and the frequent devastating earthquakes and tsunamis in the last decade caused considerable material damage and human casualties and require more than ever a review of the approach on nuclear safety in the EU and worldwide.

Where are the major deficits?

- Limited legal framework for EU action in the Directive on nuclear safety and the need to revise the Euratom Treaty which purpose to strengthen the competence of EU and achieve better transparency and an urgent update the Treaty in regard of the goals on total energy politics contained in the Lisbon Treaty.
- Increased control over the expansion of nuclear energy in the Baltic Sea region and the EU countries for strict compliance with safety standards and environmental protection, especially in those countries which build nuclear power plants near external borders of the EU;
- Solidarity with the victims of nuclear accidents and natural disasters and strengthening the control on import of food originating from areas affected by nuclear accidents , aiming at limiting the risks for the human health and also regulations provided in Regulation No 733/2008, which refer to stricter and more updated ways of protection;
- Introduction of control aimed at providing real time information about the level of the radioactivity levels outside the prohibited zones;
- Member States to impose temporary memorandum on development and application contracts to build new Nuclear reactors, at least for the period in which the conduct and evaluate stress tests are performed. They must be mandatory and based on common and transparent Community criteria under the supervision of independent experts who announce the results to the public.
- To introduce a list of "predictably" more dangerous nuclear power plants due to their geographical position, which are to be carefully monitored and decommissioned;
- To introduce restrictions in the UN Convention regarding building nuclear power plants in areas of seismic activity.

The first and most important goal is to assess the level of risk, respectively the nuclear safety and security. Each modernization relevant to safety can be evaluated in terms of its impact on security, before it is carried out. The question is, whether the world ready to protect Mother Earth and the humanity from nuclear disaster?

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The Effective Functioning of Transport-Distribution Systems and the Implementation of Transport Services on the Market

Svetla Tzvetkova

University of National and World Economy, Sofia, Bulgaria
svetlatzvetkova@abv.bg

Abstract. The goal regarding cargo transportation does not consist solely of moving cargo from point A to point B; it also involves its inclusion in the unbroken transport-distribution chain between sender and recipient. The necessity for effective management of the movement of material flows as well as energy and information movement will exist as long as human civilization exists. The main reserves for perfecting the transport process involve rational organization of the interaction between all participants in the transport-distribution supply chain, coordination of their interests and searching for optimal decisions that are acceptable to all parties.

Key words: effective functioning, transport-distribution system, implementation of transport services

1. Introduction

In many ways, the effectiveness of the transport-distribution system depends on its organization, which has to be aimed at the use of the following principles: unidirectionality, flexibility, optimization, integration of flows. It is defined by factors such as expenses, speed, continuity, etc.

The movement of cargo, much like the transport-distribution system, includes the activities of planning, implementing and controlling the physical transference of finished production and materials from their place of manufacture to their place of consumption with the purpose of satisfying customers and receiving economic benefits for the transport enterprise and subsidiary structures.

In the process of the functioning of the transport-distribution system balance must be maintained between speed and expenses as well as between the expenses and the quality of the transport services. The goal of the transport activity is considered accomplished if the product of required quality is delivered with the legally defined level of the warrantor's expenses in the demanded quantity, for the specified time and at the necessary location. As a continuous process, the optimal functioning of the transport-distribution system has several organizational aspects that limit its capabilities. The obstacles in the way of cargo movement, such as limited power, productivity, transmissivity, carriage fees, overload, processing capability or strict normative-legal conditions, can be overcome only by integrating the interests of all its participants. The effective functioning of the transport-distribution system is a prerequisite for the trouble-free and quality implementation of transport production on the market.

2. Transport services and the transport-distribution system

Transport has a defining role as a connecting link for all areas of the business-commercial activity, whose main purpose is to fully satisfy the real needs of both the public and separate individuals.

Transport services are not a corporeal product, but a transference of cargo or passengers in accordance with the order that the consumer has accepted. The transport activity is a product of the transport mass and the transport route. As such, i.e. a transport service, it holds value and utility value. The value is determined by the quantitative side of the cargo freight, whereas the utility value reflects the qualitative side. The latter is reflected in the public utility by the activity of the work itself.

The process of transport freights is a production system that ensures a certain purposeful technological process in accordance with which the utility value is extracted, such as useful produce. The utility value of transport is created by the freight capabilities of the rolling stock, which depend on the quantity and characteristics of the rolling stock, the length and condition of the roads, the power capacity of the manufacturing base, the qualification of employees and other factors.

Transport services are a type of activity related to the exchange of values and aimed at satisfying customers, which is not limited to consigning the right to ownership on some material product. They [1] are a result of the interaction between the service executive and the consumer or a result of the executive's work with the purpose of satisfying consumer needs.

Transport services are characterized by intangibility, inextricable links between production and consumption, interaction between executives and consumers, diversity in quality, inability for preservation, high work absorptiveness and individuality [2]. Transport services cannot exist outside the process of its supply; in other words, it cannot be hoarded. Providing such a service in practice is a sale of the work process itself, and therefore their quality is determined by the quality of the work process itself. Transport services represent a specific consumer value only at a certain time and in a certain place or sense, which significantly limits the possibilities for their replacement on the service market. All provided services are unique to the warrantor, because ultimately what remains is only the acquisition of information. Transport services cannot be demonstrated graphically so that consumers can "feel" them; often times they themselves participate in the process of offering a service (providing the necessary information, documentation, etc.), but they do not become their owners. Transport services are a process which cannot be tested before the order; it is comprised of a system of smaller actions, while its quality depends on the final assessment. The basic level of these services is estimated by the following indicators: speed, reliability, accessibility, functionality [3].

For example, the most important parameters which are taken into account when evaluating the reliability of the cargo supply system are: timeliness, cargo integrity, risk level, compatibility between the system's components, participants' image, etc. Every system, including the cargo supply one, is a system of interlinked components operating for the accomplishment of the common goal.

The transport-distribution chain is an interconnected combination of processes and resources-values, which begins with the recovery of the raw material and passes through the delivery of the products to the final consumer with the help of the methods of transportation.

The distribution network of transport-distribution systems is an accumulation of channels for the movement of the material flow, which by their nature are channels for direct distribution, i.e. for delivery and reception. The distribution channel is a combination of enterprises or individuals that either assume or impart the right to own a specific product during its movement from the manufacturer to the consumer. Cargo movement is an activity that involves planning and performing the physical transference of materials and finished products from their place of manufacture to their place of consumption with the purpose of satisfying the warrantor's needs. In order to fulfill the goal of optimizing the distribution, control over all links of the transport-distribution chain must be guaranteed.

Distribution in transport-distribution systems can be physical, channel (informational) and commercial. Commercial distribution encompasses the functions of planning, analysis, control and regulation. They are determined by the processes of moving the economic contents of the object of commercial activity, its formation and evaluation.

We should acknowledge the fact that a key term in the system is "interaction". The system, as a combination of interrelated components, forms a certain whole, a unity corresponding to the main system principles: integrity, structure unity, interrelations between structure and environment, hierarchy.

The cargo movement activity is based on the interaction between the following components: technology as a combination of transport vehicles and equipment accompanying merchandise flows; information as a sum of all the statistic and dynamic information on the movement of corporeal and incorporeal flows in the system; infrastructure of the participants in freights and enterprises; the organization of modern planning of freights featuring various types of transport and shipping agents; uniform dispatch control of freights between the different types of transport; mutual reliance between the subjects participating in freight organization. However, inter-agency disunity and cross-sectorial discrepancies cause the formation of "weak" spots at freight intersection points and hinder the incorporation of new technology.

3. Multimodal and intermodal form of participation of the various types of transport in cargo freights

The main principles of functioning of the main forms of transport participation in cargo freights (intermodal and multimodal) include: the common commercial-legal regiment; the complex approach to solving financial and economic issues regarding freight organization; maximum use of telecommunication networks and systems of the electronic document flow; the uniform process-resource principle of organizing freights and coordinating the activities of all participants in the transportation; cooperation of participants; complex development of the infrastructure of freights with different types of transport.

In practice, there are 11 possible combinations of coordinated services: R/W-A/T; R/W – water transport; R/W – air transport; R/W – pipeline transport; A/T – air transport; A/T – water transport; A/T – pipeline transport; water transport – pipeline transport; air transport – pipeline transport; water transport – air transport; pipeline transport – electroconductive transport. Here R/W stands for railway transport; A/T is automobile transport; water transport includes sea and river transport. However, corporativity is the most effective form of cooperation and partnership. Moreover, all participants in the transport process should know that they profit only when the cargo is in motion.

Without the transportation process in practice there is no cargo movement, and therefore no corporeal flow. Its primary indicators are the transport mass (the volume of freights), the transport route and the transport time (the speed of produce delivery). Time is a key factor for saving. The advantage in time as an inventory for the warrantor can manifest itself in two directions: in providing an adequate inventory by overtaking the competitors and in individualizing the inventory when delivering it to the warrantor at the same time as the competitors.

In essence cargo freights are the transference of corporeal flows by suppliers to the zone of their conversion in accordance with the "property" factor. Cargo transference means changing their location while upholding the principle of economy (reducing value and time expenses). Transport work is a linear transference of cargo in space and time along a predetermined trajectory, i.e. along a defined route. However, the law of constant volume of

the corporeal flow is observed: according to the transference of the material flow from the produce manufacturer through the mediator to the consumer, but its physical volume does not change.

The function of transportation determines its primary goal – delivering the cargo to its destination as quickly and cheaply as possible without harming the environment. The specified goal is most accurately defined by the rule of "7 R", which contains elements of the marketing mix that determine marketing tactics, i.e. a sequence of actions on the part of the transport enterprise with the purpose of successfully implementing the product in the transport market. The right product for transportation, with the right quality in the right quantity has to be delivered in the right time at the right place to the right customer with the right cost.

4. Guidelines for the development of an effective transport - distribution system

The primary guideline for the effective development of modern transport business is reducing the total time for cargo delivery. This can be accomplished by reducing the time for transference/overload, increasing the precision of interaction with partners and optimizing the backfill of transport vehicles.

Another essential moment should also be taken into account: the physical distribution companies, without being cargo owners, take upon themselves only a fraction of the finance risk related to cargo movement and processing along the distribution channel. However, the demand for physical distribution corresponds to the minimum time required for reaction when demands increase and the level of stocks, transportation conditions and the adopted manufacturing technology that comprise the corporeal flow remain unchanged.

For the purposes of increasing the effectiveness of the transport-distribution system at an enterprise level, the following goals should be set and fulfilled:

- effectively using the enterprise's manufacturing capabilities through optimal loading of capacities with consumer orders;
- managing the transport-distribution processes of cargo movement during the post-manufacturing period;
- quick and effective processing after receiving the order;
- managing the delivery and the control over the execution of the transport-distribution processes;
- guaranteeing a profit for the enterprise along with fully satisfied customer demands;
- organizing rational loading.

The effective management of transport processes offers quick, timely, precise and accurate – definition of cargo routes; loading of transport vehicles; confirmation for load-off and delivery; comprising of the accompanying documentation; cargo and load-off tracking; cargo accountancy and history.

The transport-distribution activity's main guidelines for guaranteeing additional profit at the cost of added value in the conditions of market economy include: measures related to the creation of a uniform transport sub-system for accelerating deliveries to consumers; economic unification of manufacturing and outlet; creating optimal outlines for storing and filling stocks.

The effective functioning of the transport-distribution system is based primarily on the integration of the economic interests of its participants.

The effectiveness of the transport-distribution chain is defined by three factors: expenses, speed and continuity.

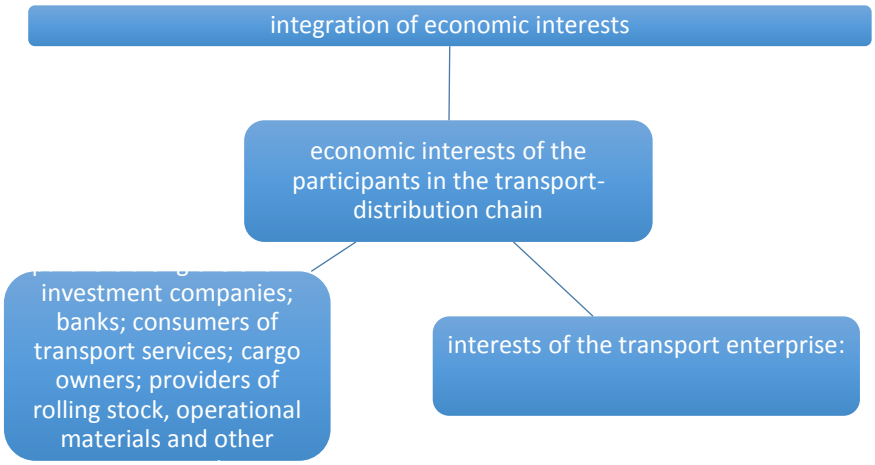

Fig. 1

It is well-known that manufacturers strive to reduce expenses, including the ones for cargo movement. Therefore, reducing the prime cost of transport operations and their share in the cargo price is the main goal of all generations. Over 30% of all expenses fall on operations involving cargo movement from seller to buyer [4].

Interaction expenses in the transport-distribution chain comprise over 50% of the general expenses. Therefore, the "reducing interaction costs" factor in the transport-distribution chain is prevalent, playing a strategic role in the functioning of these chains as a system. The observation of freight standards and schedules is also crucial and necessary since warrantors view them as an element of their own technological manufacture cycle. The maneuverability of the transport-distribution chain, which is viewed as an opportunity for transforming its structure in the event of changes to the environment, is also essential.

In order for the system to function effectively, the guidelines of the primary freight throughputs have to be defined, depending on the location of the main manufacturing powers, as well as on the trends of the territorial division of the manufacturing process itself. Therefore, enterprises service a specific territory (region, area, etc.) or transport corridors or a specific group of consumers. Additionally, in the practice of freight throughput movement there is a very precise distribution of the capital's megalopolises (consumer centers) and production-commercial distributional centers (installation-distribution platforms), which provide the consumption.

The term "cargo unit" holds an important place in transport-distribution chains; it signifies a specific amount of cargo, which is moved and stored, as a single mass. The cargo unit, grouped in the most economical way and aimed towards the same place, is called a heterogeneous similar unit between manufacturing centers and warrantors working without storehouses and terminals, which is a moment of principle for transport-distribution systems. The container can be such a unit.

A key factor in the effective functioning of the transport-distribution system is the containerization of freights. It allows: insurance of cargo delivery along the "door-to-door" system; creation of direct/uninterrupted transport-distribution cargo delivery chains featuring various types of transport; introduction of the use of containers directly in the technology of production processes in industrial companies; optimal use of railway and automobile transport

(fast and reliable long-distance cargo freights via railway transport, as well as flexibility and mobility of automobile transport in regard to the collection and distribution of cargo by territories). The use of TOFC-type freights (trailer on flat cac) – a trailer with a container on a railway platform – helps reduce expenses by 30-40%, in comparison to delivering the cargo solely by automobiles.

Conclusion

In modern conditions, the transport services market becomes an inseparable part of a uniform system – the system of cargo movement which includes not just the transport system, but also individual elements from the cargo manufacturing, distribution and outlet system; internal production transport, storage facilities, loading and unloading activities, development of leasing companies, systems for agent, broker and information service, etc. [5]. The manufacturing infrastructure also has to work efficiently [6, 7], which involves the development of a rational system for cargo movement: storehouses, terminals and complexes for loading and unloading.

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Analysis of the Synergetic and Quantum Effects of the Integrated System for Transporting Energy Resources

Svetla Tzvetkova[1], Plamena Zlateva[2]

[1] University of National and World Economy, Sofia, Bulgaria
svetlatzvetkova@abv.bg

[2] Institute of Robotics – BAS, Sofia, Bulgaria
plamzlateva@abv.bg

Abstract. In essence, the integrated system for transporting energy resources has a rather complex structure due to its high amount of constituent elements and sub-systems, as well as the intricate relations between them. This also defines the difficulty of forecasting its future development, as well as the difficulty of forming and evaluating the effectiveness of its functioning It can be presented in the conditional connection between various effects: economic, commercial, technical, innovational, organizational, managerial and collective synergetic and quantum effects. It is appropriate to emphasize that the formation and evaluation of the effectiveness of the functioning and development of the integrated system for transporting energy resources is subject not just to time, but also to the system's stability and inconvertibility.

Key words: integrated system for transporting energy resources, synergetic effect, quantum effect

1. Introduction

The development of European economy, including the Bulgarian one, is directly dependent on the state and perspectives before the energy sector. The European Union consumes about a quarter of the global consumption of energy resources, the main portion of which is delivered from other regions. This fact defines the importance [1] that the transportation of energy resources holds for the effective and competitive development of European economy.

The transportation of energy resources is a non-linear system whose synthesis is dominated by relative stability and order. According to the systemic-synergetic concept, the integrated system for transporting energy resources is an automatically fluctuating, systemically developing structure with an infinite number of interacting, fluctuating elements whose mechanisms include mobile interaction between self-organizing and organizing beginnings. The integrated system for transporting energy resources is an open, complexly structured economic system comprised of interlinked elements in a uniform managerial process; their amount, borders and goals of operation are united by the domestic goals of the countries that are participants in the energy market [2]. The integrated system for transporting energy resources, as well as most integrated systems [6, 7], is defined by the main features of complex systems that allow the implementation of the system approach in their analysis and synthesis. It is a process of studying their sub-systems and elements' methods of connecting elements in a system.

The effect of the functioning and development of integrated systems for transporting energy resources is obtained from the total amount of interconnected and subsequently

increasing their interactions results, which also leads to a qualitative new level of development.

The present article's purpose is to first and foremost examine the effects of the functioning of the integrated system for transporting energy resources, as well as the benefits from them. The second objective is to substantiate the interconnection between synergetic and quantum effects.

2. The Nature of the System for Transporting Energy Resources

The integrated system for transporting energy resources is defined by its ability to undergo changes and development with time, as well as its communicativeness and adaptability, i.e. its ability to quickly adapt to the external environment. It is a dynamic system capable of performing preset functions in a certain amount of time with the necessary qualities. The unity of the system is expressed in its integrative qualities which are unusual for its individual elements. The system has a well-organized structure of interconnected objects and subjects of management whose purpose is completing the given objective. Its reliability allows cargo freights and performing preset functions in a certain amount of time and with the required quality.

The integrated system for transporting energy resources is a combination of elements between which stable links and relations have been established. An element of the integrated system for transporting energy resources is what we call a specific economic or functionally differentiated object which is not liable to further decomposition within the set goal for analysis or synthesis of the integrated system, locally completing its set objective which involves performing certain operations and functions.

The main system-forming factors of the integrated system for transporting energy resources are: environmental – these are system-forming factors from nature; historical – these factors are formed as a result of the evolutionary development of the region and the country; social – factors which are defined by public needs; business – factors which are used in accordance with their direct purpose and the manufacturing process of energy companies; cultural – they are purposefully created to elevate the cultural level of both manufacturers and consumers of energy resources; potential – this is the untapped potential of the available system-forming factors. The manifestation intensity of each of the presented factors varies. The manifestation intensity of social and business system-forming factors can be high in one region, like the EU for example, and low in another.

The open nature of the integrated system for transporting energy resources is dependent on its functioning in a close interconnection with the environment. At the entrance of the system are concentrated informational, financial, investment and innovational flows, and at its exit – increased budgetary revenues from all levels of use of the systems' objects, development of the population's social defense, increased investment appeal of the subjects, their increased financial stability, etc. [2]. The integrated system for transporting energy resources has the ability to resist the influences of the external environment, changing its structure by necessity, based on its synergy.

3. Effects Regarding the Functioning and Development of the System for Transporting Energy Resources

3.1. Economic, Organizational, Managerial, Social, Commercial, Investment, Technical, Ecological Effects

The effects of its functioning and development can be classified into: economic, organizational, managerial, social, commercial, investment, innovational, technical and ecological. The combined effect of the functioning of this system has to be viewed as a

synergetic effect, and the resulting effect – as a quantum one [3].

Figure 1 graphically presents a conditional interconnection between effects of the functioning and development of the integrated system for transporting energy resources.

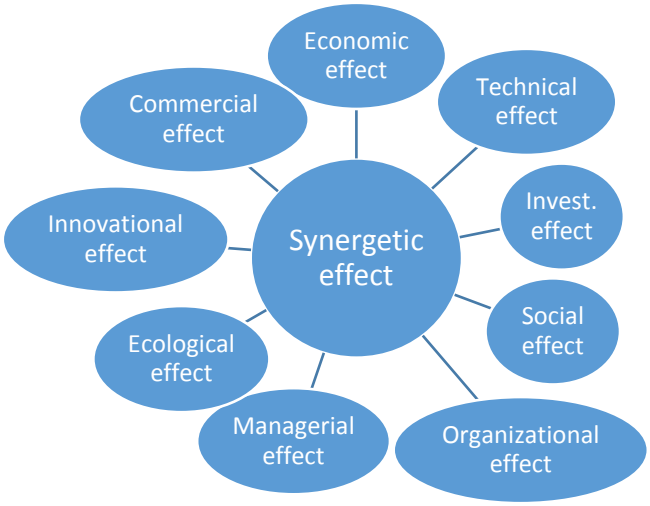

Fig. 1.

Table 1 provides a more in-depth look at the effects of the system's functioning and the benefits from them.

For every one of the aforementioned effects from the functioning of the integrated system for transporting energy resources there are specific indicators for their measurement.

- Economic effect – it is measured by: growth of income; growth of profit; reduction of expenses; saving resources; lowering fees;
- Social effect – reducing the turnover of personnel; increasing the real wage; increasing the purchasing power;
- Commercial effect – increasing the freight volume; increasing the number of service points; increasing the market share;
- Technical effect – increasing the number of freeways for transporting energy resources; increasing the quantity of repair equipment;
- Innovational indicators – increasing the quantities of introduced inventions; increasing the quantity of incorporated innovative offers; increasing the quantity of provided services;
- Improving the indicators for the quality of the performed services;
- Investment effect – growth of the income from investment activities; growth of the profits from investment activities;
- Ecological effects – incorporating technological, managerial systems that increase environmental safety, etc.;
- Organizational effects – increasing: the number of vacant spots; personnel qualification; the volume of freights corresponding to one manager;
- Managerial effects – increasing work productivity; reducing the labor intensity of the provided services; reducing the loss of office-hours.

Table 1

Effect	Benefits
Economic effect	Saving expenses for community service at all stages of the system's functioning and development
Social effect	Increasing the living standards and improving working conditions for all employees bound up in the system for transporting energy resources
Commercial effect	Growth of the natural indicators for the functioning and development of the integrated system for transporting energy resources
Technical effect	Creating new working means and tools and new technology within the system
Innovational effect	It involves discovering new phenomena from the material world or laws in its development
Investment effect	Growth of the results from the activities of participants in investment projects which are realized within the integrated system for transporting energy resources
Ecological effect	Growth of the results from the activity of the system thanks to constant and sequential integration of systems from technological, managerial and other decisions which help increase the effectiveness of using natural resources and conditions, along with improving or preserving the qualities of the environment.
Organizational effect	Growth of the results from the activity thanks to increasing the organizational harmony, with minimal losses
Managerial effect	Growth of the results from the activity thanks to acknowledging the factors of the inter-system coordination, coherency in space and time

3.2. The Synergetic Effect of the Functioning of the Integrated System for Transporting Energy Resources

At present, there is a very high level of interest in the study of the synergetic effect regarding the functioning and development of the integrated system for transporting energy resources. In specialized literature the term "synergetic effect" is rarely seen, but at the same time, the unfolding emergenetic revolution turns time into a system-forming actor and places new requirements upon the system for transporting energy resources; one of said requirements is the establishment of new categories for economic development as a synergetic effect. The synergetic effect is caused by mutually coordinated in space and time actions of heterogeneous mechanisms which lead to qualitative changes in the system.

The probability for occurrence of synergetic effect increases with the accelerating development rate of the integrated system for transporting energy resources. Synergetic effects can occur only as a result of the natural evolutionary development of the integrated system for transporting energy resources as well as from the management of external influences. In addition, the synergetic effect is not identical to the economic effect and every other effect and their totality, since it results from the manifestation of a new quality.

The integrated system for transporting energy resources is a complex one; it includes the interaction between the technical, economic, social, organizational, managerial,

innovational, ecological and other sub-systems in which the synergetic effects help the evolutionary movement to transition into a revolutionary one; they trigger its unsteady growth and its transition into a qualitatively new state.

The formation of the synergetic effect in the integrated system for transporting energy resources requires the external managerial influences on it to be congenial to its internal auto-fluctuations, to coincide as a direction of development. The conditions for functioning of the integrated system for transporting energy resources have to be harmonized in space and time. In principle, the existing "disturbances" in the sub-systems' state brought on by its activity have a positive influence on its development by aiding qualitative changes. Another necessary condition for the formation of a synergetic effect is uncovering a leading link in its evolutionary development and ensuring its self-development.

The sources of synergetic effects manifest themselves not as an algebraic sum, but as a result of the correlation between the elements, processes and phenomena that describe the integrated system for transporting energy resources for a specified period of time. Therefore, the manifestation of synergetic effects is a result of the interaction between elements, processes and phenomena describing the system within a certain period.

3.3. The Quantum Effect of the Functioning of the Integrated System for Transporting Energy Resources

The quantum effect is a spectrum of a specific amount of the state of the elements, the system's development processes and phenomena which possess positive synergetic effects. It is precisely this spectrum of combinations of the state of the elements, processes and phenomena in the system's development that leads to evolution [4].

Figure 2 presents the conditional dependency between the effects of the functioning and development of the integrated system for transporting energy resources.

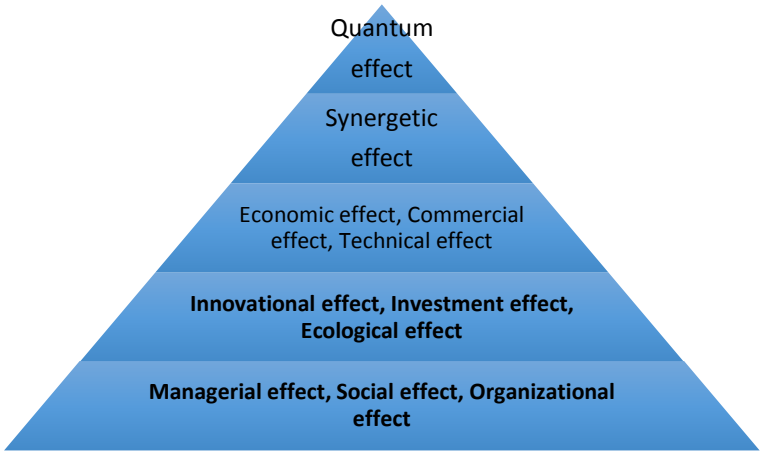

Fig. 2

The methodological and conceptual bases for the formation and evaluation of the quantum effects can be traced in the trans-disciplinarity of power engineering which serves as a bridge between synergy and other research fields.

The integrated system for transporting energy resources in which the combination of elements, processes and phenomena which possess positive synergetic effects manifests itself in the formation of new qualities for the system which ensure the discretion of its evolution.

Inferences: The formation of a quantum effect in the integrated system for transporting energy resources requires the fulfillment of the following conditions:

- coherency in time and space of the vital rates of its technical, economic, social, ecological, organizational, managerial, etc. sub-systems;
- dynamic in the state of the subsystems which aids its development through qualitative changes;
- the external managerial influences on the systems have to be congenial to its internal fluctuations;
- as a synergetic system, the integrated system for transporting energy resources has to amass information about the changes that occur in it;
- the variety of elements, processes and phenomena that occur in the integrated system for transporting energy resources on the one hand are a factor for its adaptation to external managerial influences and a basis for achieving their unity on the other;
- capabilities for uniting the sub-systems in accordance with the peculiarities of the integrated system's evolutionary development;
- defining a leading link for the integrated system's evolutionary development and ensuring its self-development.

Conclusion

The manifestation of quantum and synergetic effects is a result of the interaction between the elements, processes and phenomena describing the integrated system for transporting energy resources within a specific period of time [5].

The formation and evaluation of the synergetic effect of the integrated system's development is a study of the explosive effect with a qualitative, non-linear and irreversible nature of changes. The development of the integrated system for transporting energy resources and the evaluation of the synergetic effects are determined by the systematic interaction of its constituent elements, processes and phenomena, as well as the multiple interconnections between them [2].

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Resources for Business Security

Konstantin Poudin

UNWE, Sofia, Bulgaria
kpoudin@unwe.bg

Abstract. Business security needs resources to be guaranteed – human resources, financial, informational, natural etc. Human resources are crucial. This paper is dedicated to the business security resources. It reveals some ideas on the roles played by the personnel in the business organization for guaranteeing its security.

Keywords. Business, Business security, Resources, Human resources

Security is extremely important. According to *J. Nye* security is like oxygen: you tend not to notice it until you lose it. That is why all issues connected with it are always topical, attracting researchers' and practitioners'attention. All social systems need security to achieve their goals. Some of them are business organizations. "State of security" means absence of threats to the interests of the business. These threats come from the internal and external environment.

1. Business security

It is commonly spread that a business is an organizational entity involved in the provision of goods and services to consumers. It is also known as an enterprise, a company, a firm or a corporation. *Roger Burlton* points out that a business is an organization whose aim is to create valuable results for someone who cares about those results. [2]

Having in mind the ideas mentioned above, business security should be accepted as a security of enterprises (no matter of their name – a company, a firm or a corporation) that produce products and offer services on the market.

All of these business organizations have goals which are based on their interests. Their main goal is to make a profit, satisfying the public needs of goods and services in the desired quality, quantity, and price. After arising of the concept of Impact-driven Businesses (companies, corporations) many of them began to demonstrate also commitment to social and environmental issues as well. [6]

In one of his books *Georgi Stefanov* points out that the interests could be targeted:

- to get something valuable (e.g. a starting enterprise attracts clients and gets some market share);
- to protect something valuable (e.g. the same enterprise has to keep the acquired market share in a competitive condition) ;
- to enlarge/increase something valuable (e.g. the same enterprise has to extend the acquired market share in a competitive condition). [7]

In a very broad sense security or state of security means absence of threat to somebody's interests (getting, protecting and increasing something valuable). These threats are related to the environment – internal and external one for the given subject.

Business security means absence of threat to business's interests. It is conditions of the internal and the external environment of the firm/company /corporation /organization which is characterized by absence of threats and dangers to its interests or if there are any, the business has the ability to face them. It could be further defined as a policy on corporate level aims at anticipating and neutralizing threats to the interests of the business and creating conditions for their realization. In other words business security eliminates the threats; business security creates opportunities.

Each business organization represents a system built of subsystems – managerial, financial, HR, production, IT etc. which are interrelated. In a broad sense business security has to guarantee the normal functioning of all these systems which means that business organizations can achieve their mission and goals.

2. Business security resources

Summarizing different points of view related to resource-based view to the business *Jeroen Kraaijenbrink and Aard Groen* point out that the resources are the capacities used in a business's actions. They are the means that enable and constrain the actions a firm can perform. This means that resources allow firms to perform their actions, but that resources also constrain them in their actions. Resources gathered in the past will define to a large extent what a firm can do and what it cannot do. Yet, new resources can be gathered that extend the scope of possible actions. In addition to being inputs to a firm's actions, resources are also affected by these same actions. As such, they are outputs of actions as well. [5]

Business security goals – recognition of threats and their elimination, as well as creating of opportunities for normal functioning of the business need resources to be achieved. These resources must be managed in a good way. Some of them are presented briefly below: financial, informational, material, human resources.

Financial resources – Money is not everything but everything is related to money. The availability of enough financial resources and their good management is a guarantee for bigger business stability, ceteris paribus. Part of these resources is directly allocated for activities related to physical security, information security, and safety, as well. Other part of the resources is planned for the functional activities of the organization and in indirect way could affect organization's security. The availability of other resources for security (e.g. material resources for security - e.g. video surveillance, scanners, metal detectors etc.) depends in a large extent on the financial resources.

Information resources – Information as a resource for business security is related to different IT products which have to protect informational assets of the business. These resources are part of Information Security Management System (ISMS) developed in many business organizations, giving them strategic advantages.[8] Information resources are also associated with a specific knowledge, know-how and experience based on systematic and constant benchmarking analyses. They are also related to the availability of reliable, complete, and on time information about the different processes in the internal and external environment that can jeopardize business organization's interests or allow it to gain competitive advantages.

Material resources – Material resources include tools (most often different types of technical systems) which are used to guarantee different security aspects – physical, information, personnel or combination of them.

Human resources – This is the resource that resides in knowledge, skills, and motivation of people. Human resource is the least mobile of the four factors of production, and (under right conditions) it improves with age and experience, which no other resource can do. It is therefore regarded as the most important and productive resource that creates the greatest

and longest lasting advantage for an organization. [3] Business security depends primarily on human resources.

3. Staff's Roles in the Business Security

Human resources have a crucial role in each organization. They are very important with their skills, abilities, motivation, moral and attitudes when it refers to the business security. In a broad sense all of the employees could contribute to enhancing security in the business organization. Qualified and highly motivated personnel, having positive attitude to the work, guarantee stability and prosperity of each business. Each member of the team could threaten the business security. Unqualified and unmotivated personnel with low morality and negative attitude to the work can cause huge losses for the business organization.

The top managers are responsible for the business success. They are responsible for the business security, as well. Usually the high-level managers are supported by security manager known as Chief Security Officer (CSO) or Chief Information Security Officer (CISO).

The CSO/CISO is a part of the top management or closely related to it. He/she is responsible for the security of personnel, physical assets of the corporation and the information stored in it on paper and/or electronic forms.

The CSO participates in the development of corporate security strategy. He/she gathers, systematizes and analyses information about events and threats that might jeopardize the safety and security of personnel, assets and reputation of the corporation. The CSO is responsible for leading and building a strong security culture where people have a high degree of security awareness.

According to ASIS International the CSO fulfil the following functions:

- *Relationship Manager* – Develops, influences and nurtures trust-based relations with the leadership of the organization, public officials and professional organizations. Advises all organizational clients.
- *Executive Manager and Leadership* - Builds, motivates and leads a professional team attuned to organizational culture, responsive to business needs and committed to integrity and excellence.
- *Subject Matter Expert* – Provides and sees to the provision of technical expertise appropriate to knowledge of risk and the cost-effective delivery of essential security services.
- *Governance Team Member* – Provides intellectual leadership and active support to the organization's governance team to ensure risks are made known to senior management and the Board.
- *Risk Manager* – Identifies analyzes and communicates on business and security related risk to the organization.
- *Strategist* – Develops global security strategy keyed to likely risks and in collaboration with organization's stakeholders.
- *Creative Problem Solver* – Aids competitiveness and adds value by enabling the organization to engage in business processes to mitigate risk. Be a positive change agent on behalf of organizational protection. [1]

Most of all the CSO could have skills for conceptual and analytical thinking. He/she has to be devoted to the business organization and own responsibilities. The communication skills are a must for successful performance. The CSO has to be able to work in a multinational and multicultural environment.

CSOs are usually executives and many corporations want them to have advanced degrees in business or come to the position with significant security experience. That is why many CSOs come from law enforcement backgrounds. [4]

4. Conclusions

It could be concluded that all business organizations need security to achieve their interests. Security is conditions of the internal and the external environment of the business organization which is characterized by absence of threats and dangers to its interests or if there are any, the business has the ability to face them.

Each business organization needs resources to guarantee its security – human, financial, informational, natural etc. Human resources play a crucial role. All of the employees could threaten the business security or could contribute to enhancing security in the business organization.

Security related positions exist in each business organization. Some of them are at the managerial level, while others are at the operational level.

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Mobile Digital Platform in Logistics and Warehousing Processes

Krassimira Shvertner

FEBA - SU, Sofia, Bulgaria
shvertner@feb.uni-sofia.bg

Abstract. The paper reviews current trends in research and application on mobile digital platform It traces the emergence and development of the concept. The computer hardware platform has changed dramatically with the introduction of mobile computing devices, from iPod in 2001 to the iPhone in 2007 and the iPad in 2010. Worldwide, 2 billion people use smartphones. These mobile devices are seen as a second computer hardware platform that is powered by custom mobile devices. More business computing is moving from PCs and desktop machines to these mobile devices. Managers are increasingly using these devices coordinate work, communicate with employees, and provide information for decision making. iPhones, iPads, Android tablets and smartphones represent new emerging computing platforms based on an array of new hardware and software technologies. Logistics and warehousing business processes are driving the mobile technology development in business: deliveries in real time, traceability of goods, warehouse operations in real time associated with sales and others. Mobile devices are intermediaries that enable more efficient data collection and inserting in corporate information system (ERP system) where data associated with that obtained from other modules, and data in the database can use for analysis.

Keywords. Cloud Computing, Mobile Technologies, ERP, SAP/R3.

1. Introduction

A continuing stream of information technology innovations is transforming the traditional business world. Examples of transforming technologies include the emergence of cloud computing, the growth of a mobile digital business platform based on smartphones, netbook computers, and, not least, the use of social networks by managers to achieve business objectives. Most of these changes have occurred in the last few years. Mobile technologies enable entrepreneurs and innovative traditional firms to create new products and services, develop new business models, and transform the day-to-day conduct of business. Another macroeconomic trend busy transforming society and the global economy are work mobility and digital collaboration. The benefits of video communications include greater productivity, as it can have person meetings without ever leaving the office. It can bring geographically dispersed teams together for faster decision-making; lower travel costs; and increase employee satisfaction.

There are three interrelated changes in the technology area: the widespread adoption of the mobile computing platform; the growing business use of "big data," including data from Internet-linked networks of sensors, known as the Internet of Things (IoT); and the growth in "cloud computing," where more and more business software runs over the Internet. iPhone, iPads, Android tablets, and smartphones represent new emerging computing platforms based on an array of new hardware and software technologies. More and more business computing is moving from PCs and desktop machines to these mobile devices. Managers are increasingly

using these devices coordinate work, communicate with employees, and provide information for decision making. It is seen as a "mobile digital platform" [1].

Worldwide shipments of PCs, tablets and smartphones are predicted to exceed 2,353 billion units in 2018, an increase of 2.0% from 2017, according to Gartner, Inc. This would be the highest year-over-year growth since 2015. Mobile Phones are predicted to exceed 1,936 billion units in 2018. The misconception persists that the world has gone mobile and relies solely on smartphones. "However, our latest online end-user survey shows that users depend just as much on PCs or tablets as they do on smartphones," said Ranjit Atwal, research director at Gartner. "Forty percent of respondents said that they use mostly a PC/tablet for certain daily experiences, such as reading and writing detailed emails or watching videos, while 34% mostly use a smartphone for its convenience while on the move." Traditional PC shipments are forecast to decline 4.4% in 2018 while mobile phone shipments are expected to increase 2.4% [4].

Managers routinely use so-called "Web 2.0" technologies like social networking, collaboration tools, and wikis in order to make better, faster decisions. By connecting employees working on teams and projects, the social network is where works gets done, where plans are executed, and where managers manage. Collaboration spaces are where employees meet one another even when they are separated by continents and time zones. International virtual teams can develop the complex business projects using modern development tools and mobile technologies.

The strength of cloud computing and the growth of the mobile digital platform allow organizations to rely more on telework, remote work, and distributed decision making. This same platform means firms can outsource more work, and rely on markets (rather than employees) to build value. It also means that firms can collaborate with suppliers and customers to create new products, or make existing products more efficiently [1].

Businesses continuously seek to improve the efficiency of their operations in order to achieve higher profitability. Information technologies are some of the most important tools available to managers for achieving higher levels of efficiency and productivity in business operations, especially when coupled with changes in business practices and management behavior.

The use of mobile technology in business and the level of integration between technologies exists entirely due to business needs and is focused on optimal control of the organization. Organizations discover the importance of mobile technologies (87%) and what competitive advantages they bring (73%) and most (54%) plan to increase their investment in mobile technologies according to research by Gartner.

Rapidly changing market conditions encourage companies from different business areas using mobile applications. This enables them to improve their efficiency and quality of interaction between staff and communicating with customers. With the acceleration of business processes appear more companies operating in online mode that mobility becomes a matter of paramount importance.

Mobile device is a general term for any handheld computer or smartphone. Tablets, e-readers, smartphones, PDAs (personal digital assistant-PDA) and portable music players with smart capabilities are all mobile devices. The popular devices which are used to secure corporate mobility are smartphones BlackBerry, HTC, iPhone and Motorola. Mobile devices have similar characteristics: Wi-Fi or cellular access to the internet, a battery that powers the device for several hours, a physical or onscreen keyboard for entering information, size and weight that allows it to be carried in one hand and manipulated with the other hand, touch-screen interface in almost all cases, a virtual assistant, the ability to download data from the internet, including apps and books, wireless operation.

According to research firm BoxTone 73% of U.S. companies plan to implement in their business processes smartphones and tablets, the most intense interest in such initiatives demonstrate the organizations from healthcare and retail.

Another study of the company Good Technology, which specializes in developing enterprise applications for the iPad, shows different results - most interest to mobile applications exhibit financial organizations (36%), followed by the organizations in the field of health.

Whichever industry shows the greatest interest in mobility, it is worth to note the results of a study of Cisco, according to which 18% of the executives surveyed have had to comply with the ban on the use of the iPad in the process. It is difficult to ensure effective protection of the consumer level devices of mobile employees. This is achieved on the level of the platform applications [6].

It should be noted also that the global specialist companies who market comprehensive mobile enterprise solutions are not so much, but now there are those who gain popularity - among them, Antenna Software, Spring Wireless, Sybase, Syclo (acquired by SAP in 2012), etc., and certainly for their success in this promising market contributes that have managed to successfully implement solutions for major clients.

2. Business Processes in Logistics and Warehousing

Enterprise software is built around thousands of predefined business processes that reflect best practices, see for example [11, 12]. Companies implementing this software first have to select the functions of the system they wish to use and then map their business processes to the predefined business processes in the software. If the enterprise software does not support the way the organization does business, companies can rewrite some of the software to support the way their business processes work [1].

Logistics is a business process that is part of the supply chain (Supply Chain Management) and is responsible for planning, implementing and monitoring the efficient flow of goods and services and necessary information from point of origin of material (raw material suppliers, manufacturers) to the point their consumption (distributors, retailers, consumers). Logistics activities and includes features such as internal storage, warehousing, transportation management, distribution and management of customer orders. Internal warehousing is a key part of the supply chain activities, the warehousing management system is a part of the overall logistics management system [8].

An inventory is quite complex as it extends to all other functional areas. And the supply of raw materials, and production and sales ultimately depend on the store. The main objectives of the system are related to the control of the movement and storage of materials within a warehouse and recording of transactions from the production processes of materials and its insertion and removal of materials and their expedition. Other objects relate to the optimization of the storage material in the storage locations, such as in real-time monitor the utilization thereof. These objectives ultimately a purely economic basis, and can be summarized as follows:

Reduce excess inventory. Storage systems improve the turnover of inventories and work for "just in time" inventory, exactly when needed without excessive hoarding;

• Reduce work costs. Automating the process reduces work unnecessary operations in the storage;

• Increase the capacity of the warehouse. Optimal allocation of stocks leads to the release of land that ultimately has financial terms;

• Improved customer service. Optimal storage operations lead to timely and accurate delivery of finished products to the customers of the company;

• Increased accuracy in determining availability. Systems give a clear idea of what is stored in the warehouse from which materials, batch and expiry dates and which warehouse locations.

The storage systems is also part of the management of the supply chain and may exist either as autonomous systems or as module of the ERP systems, together with the financial modules and the modules Sales and Distribution [9].

Fundamental characteristics of the warehouse management system are:

- Allocation of storage space in different areas and storage areas. This allows better tracking of the materials inside the store and enables a graphic illustration. Warehouse workers improve the efficiency of their work as the unnecessary movements in the warehouse are minimized. Also the usage of the storage areas is optimized.
- Ability to track every movement, including receipt of raw materials and goods for production and to track the moving of production and sales materials in the storage areas. Registration of movements resulting in improved accountability and minimize losses.
- Availability of tools that can be planned for operations and inventory. Hoarding of finished goods or shortages are the biggest reasons for incurring losses from companies as financial, and competitive advantages. Management systems enable storages to address these problems.
- Integration with mobile devices and/or barcode scanners. Scanning of EAN code or other information in the form of a bar code makes it easy to input the data and speeds up operations, rising performance in storage.
- Control Tools. Inability to carry out such traceability of batches of materials is a key issue in today's competitive environment.

Generally each store performs four main functions, which are set at the heart of any system of internal control and warehouse whose characteristics it seeks to cover: acceptance of materials, storage of materials, picking of materials, delivering of materials.

3. The Mobile and other Technologies in the Warehousing

Labelling and tracking logistic units - Today many companies operate supplying equipment for label printing. They are named „equipment“, because these machines sometimes go beyond the ordinary printer, and are integrated with production functions. For example, at the end of the assembly line, where the pallet production exits, a special function machine reported passing through a sensor and initiates label printing, then "mechanical arm" puts him at a certain place in the standard GS1. One producer of such machines is Zebra, which is specialized in the production of both small printers for printing labels for small packages to integrated machines which are described above. In today's world such manufacturers are seeking integration with producers of ERP systems, particularly in systems for warehouse management. This is necessary because the printing of labels is initiated from the ERP system. This is based on the fact that the ERP system stores the data for printing and so a new scanning is avoided. Zebra is a partner of SAP and the specific language of the printer (ZPLII) is fully integrated into the system programming language ABAP used for programming in SAP. In the program code can be entered code lines of the language of the printer, which are detected and executed [10].

Thanks to these technologies, the logistics label (as an important part in the identification of the product) bears the required information for the business process and is a key element of the solutions for warehouse management.

Mobile technologies and devices - The development of mobile technology goes hand in hand with the development of the "user" or with other words of mobile devices and their

operating systems. Major operating systems in use are Windows from Microsoft, Android from Google, Symbian of Nokia, Blackberry OS from RIM, iOS from Apple and many others. Devices that work with enterprise applications in warehousing and sales are mostly on Windows operating system – Windows CE, Windows Mobile 5.0, 6.0, 6.5.

By using a computer, a USB cable and applications like Windows Mobile Device Centre (for Windows 7) or ActiveSync for lower versions can be a link between the mobile device and the computer and allows to synchronize data between the two devices and to use a variety of business applications and processing applications. All operating systems have browsers that use the same technology for network connectivity, which in turn gives ample opportunity to work in a web environment, regardless of operating system.

There are many manufacturers of smartphones, but not so much manufacturers of enterprise devices. The Company Motorola is one of the leading manufacturers of such devices. Its biggest competitor is Intermec Inc. Other manufacturers are PSION, manufacturer Workabout Pro 3, NEO, Ikôn, Omnii XT10, EP10, 8500 Series vehicle mount devices and Datalogic with products ELF and Scorpio. Although all they are with different characteristics, they have a number of common features like:

- 802.11 GSM/GPRS/3G connectivity and communication - which enables operators to work remotely in the warehouse and to save the data directly in the system instead on paper;
- GPS – this function is mainly used to identify the specific location in big storage areas or when working outside;
- Voice commands - a command voice facilitates the operators;
- Bluetooth and USB port - allows connection for data transfer to other devices, mostly desktop;
- Scanning module - covers all barcode standards in most cases, 2D barcode;
- Processor, 256 MB RAM and Flash memory;
- Keyboard with private letters and function keys;
- Batteries 3000/5000 mAh - the lifespan of the battery is essential to assure not interrupted workflow;
- Terminal Emulation - allows remote operation on another device, and in many cases is a way to transmit data to the ERP system;
- Web browser;

Ability to operate in extreme temperatures and impact resistance.

4. Implementation of the Solution for Warehouse Management

The company SAP currently has an information system, with embedded modules Warehouse Management, Finance and Accounting, Controlling, Production, Sales & Distribution and others (figure 1). The system was purchased as All-In-One solution from SAP, is the basic solution and over time there have been added functionalities to cover all business processes. SAP system has three-tier client / server architecture. All data is stored in a centralized database (physical one DB server) and is processed by the application on the Application Server. Application Server provides the logic and functionality of the system. SAP-GUI front-end (presentation level) is the interface to end users. Different levels communicate through network protocols.

The exact configuration of the SAP system in a specific business enterprise consists of two subsystems (SAP WM (Warehouse Management), SAP LE (Logistic Execution)) of the ECC (ERP Central Component) 6.0.

Fig. 1 http://www.dhc-gmbh.com/kompetenzen/sap-consulting/sap-ecc/

There are implemented three systems:

- Setup and Programming System (DEV - Development) - used for system settings (customizing), modifications and for programming features beyond the standard and test parts of the system.
- Testing System (QAS - Quality assurance) - used by consumers for complete testing solutions.
- Production system (PRD - Productive) - the system in which the consumers bring real data.

The three-dimensional configuration provides an isolated environment for modifications and tweaks test environment and production system. Changes made in DEV are recorded and subsequently transferred to the QAS system for test, training and verification by means of the SAP transport system (STMS). Thus all settings, development and new versions of the product are tested prior to be implemented in the PRD system It is possible to use also two-dimensional architecture – one system acts as the DEV and the QAS system and various clients of the system can access it. The PRD is separated in a second single system.

The aim of every project in this field is to implement an information system in the warehouses to allow traceability of materials (raw materials, packaging, semi-finished and finished products) pointing to the location inside the warehouse. Additionally labeling of pallet units with information about the lots is done – also expiry dates are typed. The warehouse workers are using mobile devices with barcode readers. Using the modules of the main SAP information system it is possible to provide the necessary information on where the products should be submitted or where the material has to be taken. The chosen solution is a module of SAP - the Warehouse Management (SAP WM) module.

SAP Warehouse Management module is fully automated and flexible product covering all movements of materials in storage and supports all logistics processes in supply chain of raw materials and sale of finished products. SAP WM is fully integrated with the other components and modules such as Purchasing, Production, Sales & Distribution and Warehouse. Business processes, that began in other software components lead to movement of materials in the warehouse. With SAP Warehouse Management module the warehouse can be divided into parts of areas, sections, and warehouse locations, and so provides an opportunity not only to monitor the availability of the material for the entire store, but to point exactly in which storage locations the material it is stored. The companies are trying to achieve materials tracking on pallet-unit level with full stock control without tolerance in this respect. This means that the loading units contain quantities of batches that are available in the system

and are controlled by the other modules. The scope of the task covers all logistics processes in the company, without exception, including:

- Control of the input processes - processes of delivering the raw materials from suppliers, acceptance of returned goods by customer acceptance of manufactured finished goods in the warehouse, produced in the manufacturing process;
- Control of the output processes - Material staging to production supply areas, picking and shipping goods for sales ;
- Control of movements inside the warehouse - move materials and pallet units between different zones, sections and warehouse locations and processes blocking and unblocking of stock in quality control, which is not associated with the physical movement of material;
- Control of traceability in sales to customers - a reference number of the pallet unit to give a clear idea of what material the products are manufactured, with which batch, expiry dates and production dates.

For projects with implementation of the warehouse management module the methodology ASAP (Accelerated SAP) is used. This methodology is based on a phased approach for planning and management that achieves the following:

- Detailed time planning the project and load the resource;
- Reduced time for implementation;
- Define clear criteria for moving from stage to stage;
- Ability to measure and new parameterization of each stage.

The main phases of this methodology are the following:

Project Preparation - Obtaining senior-level management/stakeholder support, Identifying clear project objectives, Architect an efficient decision-making process, Creating an environment suitable for change and re-engineering, Building a qualified and capable project team;

Business Blueprint - preparing the document, which define the business processes which are base of the subsequent implementation;

Realization (phase of implementation) - configuring the system to transmit knowledge to users, system testing, data migration, etc.

Final Preparation includes final system testing and implementation of training for users;

Go Live and Support (productive start and maintenance) - data migration from the old system, activation of the system and support period.

5. Description of the Decision to Use Mobile Technology

For entering data into the SAP system through a mobile device the functionality "Entering mobile data" will be used as part of the module SAP WM. It represents a set of basic transactions and functions that can be performed through simplified screens in contrast to the real screens from SAP system. These screens are displayed on the unit via Web Browser. This integration is achieved through technology ITS (Internet Transaction Server) and their services. The technology is illustrated in figure 2.

The Internet Transaction Server (ITS) consists of two components AGate and WGate. Their main functions are as follows:

The component AGate:

- Loads a file with ITS services and related parameters that are set in this service;
- Sends queries to SAP Application server;
- Obtains screens of SAP Application server (screens of dialog programs);
- Formats these screens in HTML;
- Sends formatted as HTML screens to WGate components.

The component WGate:

- Refers inquiries from the web server to AGate;
- Sends HTML pages from AGate to Web server.

ITS server technology allows direct access to the SAP system from both mobile devices and desktop systems. The input of the information in the mobile device is done via Internet browser and reflects in real time in the SAP system. There is no need to record data in separate databases on the mobile device and to be synchronized with the database of the information system.

The core function of the ITS server is to load the ITS service, so the SAP system such ITS service will be created. It is a combination of two elements: SICF service and Internet Service.

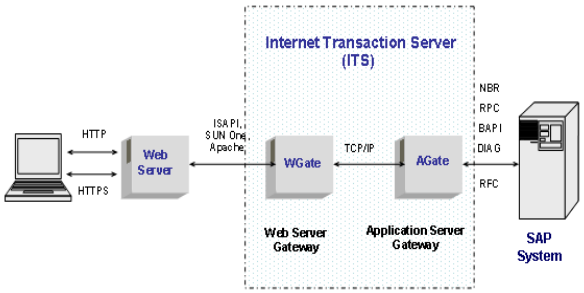

Fig. 2 Technology ITS (Internet Transaction Server)

First the SICF service is created. This component is part of the Internet Communication Framework (ICF), which is an integrated part of the SAP Web Application Server. ICF provides an environment for processing HTTP requests to ABAP processes of the SAP system. The SAP Web AS can move these HTTP requests using the ICF as a client or as a server. SICF service points to the Internet Service, which is set of parameters in the definition of the former. These parameters are connected to the form on the screen, time-out of the system and other.

The Internet Service points to the standard transaction for mobile applications in warehouse.

After the creating the ITS service a path is generated, that allows to call the service through Web browser and to display the screens of the mobile transaction.

SAP's warehouse module will be integrated with a mobile devices Datalogic Elf (PDA type) with a scanning unit and a wireless network connection. The devices have the following main specifications:

- Ergonomic and compact design - no handles and can be attached to the belt of the warehouse worker
- Operating System Microsoft Windows Mobile 6.5 with IE
- UMTS HSDPA mobile radio communication
- Summit client for 802.11 a / b / g radio and Bluetooth ®
- Scanner unit, including 2D barcodes and Integrated HF RFID reader
- 256 MB RAM / 256 MB Flash and XScale ™ PXA 310 @ 624 MHz processor
- Slot for memory card
- Wavelink Telnet Client.

Normally printers type ZEBRA model ZM600 are used with the following specifications:

- 300 dpi, label width 104 mm, supported the language ZPL II.

In the SAP system printed forms can be developed with SAP Script and Smart forms (a new technology with an intuitive interface and new features such as integration of all types of barcode without direct use of language ZPLII in scripts). Advantage of Smart forms is the integration of all types of barcodes.

The presented details of the main characteristics of a warehouse management module within the enterprise mobile solution for inventory management in SAP information system provides convincing arguments for the integration of mobile technology in business today. The presented solution not only displays and records transactions but also defines and summarizes the information that can be transmitted to the management within the company.

The Warehouse Management module is an example of the opportunities provided by the integration of information systems and mobile technologies, and provides a basis for reflection on the diversity of options available to information systems. The modern company employee needs information wherever he is located, and now we have the technology to receive it. Other such examples of the integration of IT and mobile technologies can be:

- Implementation of data from mobile units for maintenance in the enterprise;
- Data entry of sales orders from mobile sales representatives;
- Implementation of data related to human resource management such as leave requests;
- Data Entry for managing the assets of the enterprise, especially for firms located in multiple locations;
- Approval of documents by the management of the company.

According to Gartner, the platform of SAP - SAP Unwired platform is a leader in this regard after the acquisition of the company Sybase, followed by Antenna and Syclo. SAP now offers a platform in the "cloud", thus licensing costs becomes quite acceptable for customers.

6. Conclusion

Although there are already enough examples of the positive effect from the introduction of mobile technology in business processes in this area still has a lot to be desired. In particular, the IT industry has not yet developed a unified approach to the formation of corporate policy governing the rules for use of mobile devices. Recent study commissioned by Cisco shows that there is a considerable gap between corporate IT policies and lifestyles of employees who become increasingly mobile. Within this study surveyed are 2,600 employees and IT professionals from different countries. It turns out that 82% of companies have a policy on the use of mobile devices, but 24% of their employees are unaware of it, and another 23% are not familiar with essential requirements of this policy. Meanwhile, the market offers more control decisions on the use of mobile devices.

The challenges in the implementation of corporate mobile solutions and future developments can be judged from the results of the recent study carried out by Economist Intelligence Unit (EIU) on behalf of Symantec. This study is titled "Fonts of Innovation - Mobile Development in the Business" and is directed to the study of innovation in mobile solutions organizations in Europe, Middle East and Africa (EMEA) [7].

According to the EIU, organizations increasingly rely on mobile solutions in their work and their competitiveness increasingly depends on the ability to generate new ideas for implementation of these types of solutions. But the study found that when it comes to innovation in mobile technology, IT departments often can’t find a common language with other divisions of the company. Only 10% of surveyed employees determine their IT colleagues in this area as "very innovative."

Main problems in the effective use of mobile technology are to improve cooperation and integration. Despite disagreements between IT and the business for all involved is obvious that the implementation of innovations in the mobile sphere requires the active cooperation of all employees in the company, whether they are IT professionals and IT users.

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Application of Information and Communication Technologies for Building a Sustainable Society

Violeta Vasileva[1], Veselina Aleksandrova[2], Anna Guncheva [2]

[1] HWR - Hochschule für Wirtschaft und Recht /
BSEL - Berlin School of Economics and Law, Berlin, Germany
violetta.ziv@gmail.com

[2] Rakovski National Defence Academy, Sofia, Bulgaria
alexandv@yahoo.com, add1967_2000@ yahoo.com

Abstract. Using intelligent systems represent a real support for sustainable city development, and respectively building a sustainable functioning society. The road towards incorporating the aspects of social responsibility within systems and organizations is an ever-evolving process which starts with integrating sustainability in all aspects of life – technological, societal, economic, environmental and urban. This paper analyzes the growing importance of information technologies and their implementation in the concept of Internet of Everything which evolve towards intelligence and sustainable development, and identifies the key elements of developing smart ('intelligent') cities, as a premise for building a sustainable-structured society.

Keywords. Corporate social responsibility, smart cities, sustainability, information technologies, intelligent solutions, Internet of Everything.

1. Introduction

Life in human societies is constantly accompanied by exchange and release of information. The information has great importance in all fields of human activity – from daily operations to global performance. For that purpose in different countries all over the world, information institutes are established. Intelligent knowledge extracted from information has a material and social significance for any human activity. However, in the sphere of economic, social, and psychological development of our society, the main issue is linked to deliver the right information at the right time and to the right place. An appropriate new technology could realize this process, thus, providing the premise for experiencing changing behaviour and building completely new business models and social structures.

The purpose of this paper is to identify the challenges that our modern society faces today, to reveal the impact of information technologies in all aspects of our life, our dependence on them and the need for them. The "smart city" concept is a key factor for the support and delivery of a new sustainable social model. This objective could be achieved by the implementation of the contemporary information and communication technologies where the emerged concepts of Internet of Everything (IoE) and Internet of Things (IoT) can be used as a tool. The research question of this paper is to identify the needs, trends, reality and challenges that our society is facing today in the context of the urban development and environment and to propose suitable solutions. For that purpose, the object of study is the analysis of the constantly developing information technologies. Their implementation for solving the mentioned above challenges will help to build a sustainable functioning society. The latter is achieved by exploring the capabilities and impact of information technologies

nowadays and their application towards intelligent systems for serving social needs. Respectfully, helping to successfully meet the demands of a sustainable society as well as providing quality of smart city planning today and its preventive management is very important for our society.

Correspondingly to the aim, the paper is structured in the following way: point 2 analyzes the new trends in the development of the urban environment in order to identify contemporary challenges and problems that our society faces today. For that reason point 2 also explores the reference materials to identify how recent technological advancements have affected urban, economic and social features, resulting in advanced developments and innovation and introduces the concept of smart cities as a solution that can meet today's challenges. Point 3 proposes modern information technologies as a tool for realization of a smart city concept and in this way to be a prerequisite and basis for building a sustainable society. For that reason the development of information technologies and their implementation through the concepts or Internet of Things and its evolution to Internet of Everything are also presented. Point 4 represents some implemented smart city solutions that reveal how thanks to the implementation of Internet of Everything concept as an information technology tool, the myth for a "smart" city is becoming transformed into reality. Point 5 of the paper discusses conclusions that emerge in regard to building a sustainable functioning society and proposes some suggestions and ideas for future researches and developments.

2. The reality and challenges that society faces today

We find ourselves living in times facing huge climate, economic and social problems. They could be about fresh water and food supplies, medical care, education, and energy. For that reason in our age sustainability is a major global issue that requires urgent attention with the intensification of human activities that outrageously use natural resources and degrade the environment. The development of a sustainable community is one of the effective solutions.

A serious focus is placed on nature and the danger of highly complex global systems. Indeed, the first decade of the twenty-first century has given a series of wake-up calls, regarding a specific theme: the reality of global integration and constant information flow and the exchange. As Jared Danaraj, the Director Business Development Internet of Everything and Emerging Solutions of the Cisco Systems, says, the 19th century was the Century of Empires, the 20th century was the Century of Nation States (NATO, Warsaw Pact, etc.) and now 21st century is the Century of Cities.

One of the main challenges is found in the fact that the world is now urbanized. According to research results provided by Cisco Systems about the percentage of population living in the cities for the last 300 years, in 1800 – 3% of the population lived in the cities, in 1950 – 29%, in 2008 - 50% and by 2040 this figure is predicted to rise to 65%. These figures show that the majority of the world's population is moving and developing towards urban communities. Currently, there are 1.3 million people moving into cities each week, and there are 21 megacities with over 10 million population. Up until 1975, there were just these – New York, Tokyo and Mexico City. Currently, the largest city is Tokyo with a population of 36 million. If this city was a country, it would rank 35th in population size. Urban experts predict that by 2025 the number of megacities is expected to reach 29, with an additional five in Asia – Shenzhen, Chongqing, Guangzhou, Jakarta and Lahore; two in Latin America – Bogota and Lima; and one in Africa - Kinshasa.

Another challenge is that the number of cities with more than one million people has increased. For example in 1900 the number of cities with more than one million people was 12, in 1950 – 83, in 2011 over 500 and by 2025 China alone will have 221 cities with more than one million people. In this regard, cities have huge economic influence. The top 600 urban

centres generate 60% of global GDP. In the developing world, as much as 80% of future economic growth will occur in cities. However, their environmental impact is even more. Cities use between 60% to 80% of the world`s annual energy needs [13]. Moreover, urban areas bear the highest responsibility regarding global energy consumption and respectively the caused climate changes. The twenty biggest cities in the world, each with a population above 10 million, hold 75% of the whole planet`s energy consumption.

The rapid metropolitan and urban development increase the need for transforming the old infrastructure, inherited by the 20th century into more integrated, optimal and synchronized one. This need introduces greater and greater challenges to urban architects and planners. However, there is definitely "light in the tunnel" – the introduction of Information and Communication Technologies (ICT) in urban planning as a new tool to face the challenges present in the area of ecology, transportation, housing policies and infrastructure [10].

Unfortunately, the traditional cities` structure has not addressed these issues with an integrated approach. In general, city departments make investments independently resulting in:

- not sharing of infrastructure and IT resources and information;
- waste and duplication in investment and effort;
- difficulty in scaling infrastructure management.

This results in dysfunctioning of urban and social structures. It is a fact that in the world one in five people living today lacks safe drinking water. The other threats are the financial markets, with their uncertainty and high probability for risks without tracking them.

Based on the facts mentioned above it could be concluded that this fragmented approach is inefficient, has limited effectiveness and is not economical and social from an ecological point of view. In this respect, a new "intelligent" or "smart" social structure is needed. A structure that will provide a high-level architecture and end-to-end city network [13], where there is a city-wide connectivity for people, sensors, machines, ICT devices, and infrastructure. In this way, services could be delivered and facilitate the movement of everything from money and oil to water and electrons. This model respectfully helps billions of people work and live all across the world.

On the other hand, the world itself is becoming an instrument. Billions of devices and transistors are engaged with the existence of human beings. Sensors are being embedded in the majority of products, materials and tools – in cars, appliances, cameras, roads, pipelines, even medicine and livestock.

Moreover, the world we currently live in is becoming more and more interconnected. Information technology is developing – soon there will be two billion people on the Internet [13], and at the same time, the systems and objects can also communicate with each other by exchanging data. Basically, this comprises a huge network with 'oceans' of data being generated. Meanwhile, communication technologies and information devices are becoming intelligent. They are being linked to a powerful backend system that can process a huge amount of data and advance analytical tools that possess the capability of processing that data into real insight, in real time.

By analyzing the need to connect devices to build a sustainable society, it can be concluded that information technologies that realize the Internet of Everything (IoE) concept could meet most of all challenges and needs of the sustainable society.

2.1. The Development of the "Smart" Concept

The term "smart city" has a lot of definitions. However, smart cities represent a conceptual urban development model by the utilization of human, collective, and technological capital for the development of urban agglomerations [1]. What is certain, though, is that smart

cities represent a broad concept, constantly shaped by advancements in technology and urban development.

Although the smart or intelligent city is alternatively a new notion, it has been defined by many authors and institutions. The concept of the term "smart city" represents an urban and social structure that intends to deal with and mitigate the outcome generated by the rapid urbanization and the population growth – such as energy supply, waste management and mobility. The way to achieve this is through the highest efficiency and resource optimization [6]. According to the Focus Group on Smart Sustainable Cities they are innovative and use information and communication technologies to improve the efficiency of urban operations and services, the quality of life and competitiveness. The present and future generation needs will be met with respect to economic, social and environmental aspects [18]. As it can be seen in the definition, the key point is the implementation of the latest information technologies to provide quality of services and therefore to improve the quality of life. Therefore, a smart city is not connected only with technologies. It is only an enabler, a tool. Cities themselves should still have processes, regulations, standards that allow deploying and delivering the services.

Today's challenges that cities face are the increase of urbanization, climate change and therefore insufficiency of natural resources, the financial crisis that reduces the resources for city projects. The idea for smart cities has already widely spread and there are various organizations and programs which embrace this subject. Some examples are [2]:

– The project Connected Urban Development, which started in 2006 with a budget of $15 million for projects, research and equipment and it is part of Clinton Global Initiative [9, 11].

– An initiative for creating a global community of experts who will work in different cities in the world to build the concept for connected cities in order to achieve sustainable development through innovations [10].

– A platform supporting European efforts to develop smart, sustainable and inclusive economy - The European Technology Platform on Smart Systems Integration (EPoSS) [8].

– A society of software developers and other specialists who are involved in the developing of services for smart cities.

– Public and non-profit organizations participating in the smart city discourse, such as the Intelligent Community Forum network [35].

– Informative websites such as online newspapers (i.e. The New York Times) and business magazines (i.e. Forbes), or websites about urban development (i.e. The Global Urbanist [34], and Citylab [8]) that discuss "smart city" issues.

Some authors give examples about a great number of consulting companies that provide analyses and forecasts on the future growth of investments in developing information systems for the smart city environment [2]. What is pointed out is that most of the companies introduce solutions that could manage a separate service of the urban environment. Therefore, the challenge is to bring an integrated solution for the smart city environment.

Nowadays thanks to the modern information and communication technologies it is possible to meet all the challenges in the big metropolitan city environment. The new vision for smart cities is to connect all the digitalized urban systems in the network and to achieve a complete integrated solution. It means to develop the infrastructure for a city with a digital overlay. For that purpose, it is necessary to build applications for hospital optimization, intelligent highways, traffic flow optimization, logistics optimization, factory optimization, home energy management as part of intelligent digital signage and other spheres [10, 13].

Analyses of reality and needs that societies and cities face today show that there is an inevitable need to implement information technologies as a tool in order to build a sustainable society and to realize the smart city concept. That is why in the next topics we will discuss

how the development of the information technologies support the development of a sustainable society and vice versa.

3. Information Technologies as a Tool for Building Sustainable Society

From the analysis of the development of the information technologies, it could be concluded that the more innovations are discovered, the more requirements of the society are. This is a mutual process. The growth of users' needs leads to creating more sophisticated devices and "smart" machines.

According to some authors, the computer is the most sophisticated creature of the humanity [24]. We agree with that statement because this invention influences the development of all other technologies and machines. Nowadays all the machines have a computer or processor in its core; even in storage devices computers have been embedded. Furthermore, it is a base for developing the next three very important revolutionary inventions in the information technologies in the last decades. They have their impact on the society and pave the way for future developments. The first one is the client-server technology and architecture that ensures the future growth of networks. The second one is creating the Internet and the World Wide Web that links activities in all the areas in our society. And the third one is the development of mobile communications that create a new business culture in the society.

What we see as a trend is that the Internet evolves and this is a permanent process. In the beginning when networks were created as a business and social environment that was the first level in the in the 90s where the main services were limited only to connectivity. The main services were e-mailing, web browsing and searching. Then the next new level that was added to the Internet was where the business started to use it and benefit for itself. For example, there were platforms for e-commerce, digital supply chains and different tools for collaboration announced. And the third level in immersive experience business and social interaction is digitized. This is connected with introducing social media applications like LinkedIn, Facebook, and others. Social media have become a very important feature in people's life. The next level of development is the implementation of the Internet of Things (IoT) and Internet of Everything (IoE) concepts which will have a huge benefit for the business will improve the quality of life and therefore will help to build a sustainable society [1].

The Internet of Things (IoT) is the intelligent connectivity of physical devices driving massive gains in efficiency, business growth, and quality of life. The enhancement of Internet of Things (IoT) leads to increasing of the data generated by these devices and sensors put on the Internet. In the next years, IoT will explore many challenges and technologies on intelligent use and applications of IoT data [28]. According to Gartner IoT will increase up to $1.9 trillion in 2020. In the same year, the number of devices connected to the Internet will increase up to fifty billion [33]. IoT was identified by Gartner as one of the top ten strategic technology trends [17]. It is interesting that with the development of information technologies the understanding or concept for IoT is also developed.

Nowadays there are a lot of projects using the IoT concept, and therefore on IoT architecture framework and a corresponding Reference Model are developed [4, 20]. According to EPoSS, the European Technology Platform on Smart Systems Integration, which is an industry-driven policy initiative, research and innovation, needs to include Internet of Things questions [20, 14].

The IoE and IoT are connected to each other, but there is a difference. The IoT concerns processes, data and things while IoE adds the people's aspect to that.

According to a Cisco research, the IoE has a 19 trillion dollar global potential in the next decade for the companies from the private sector as well as the public sector, cities, and government organizations [19].

With the presence of such an advanced technology and an available network at such a low cost, one can realize the need for its usage and implementation. Furthermore, the necessity of presence and usage of information technologies and communication devices is inevitable not only for serving human needs and providing easy and efficient communication and solutions but because these are the systems we need to consider building a sustainable and efficiently working community. Some of the benefits from the direct impact of intelligent solutions implementation can be observed in various economic areas such as the following [27]:

- power and utility grids – integration of renewable: 25 to 40% lower investment compared with traditional grid expansion;
- building – 20 to 30% less energy consumption;
- rolling stock – save up to 30% in lifecycle costs;
- roads and rail – approximately 20% increase in city traffic speed.

For the last two areas, the impact of intelligent solutions implementation results in 20 to 30% capacity increase with driverless trains.

There are a lot of discussions about the substance of intelligence. Some authors state that intelligence involves a combination of mass heavy computation and algorithmic methods such as recursive, neural nets, and evolutionary algorithms [5]. The role of Artificial Intelligence in innovations and developing a sustainable society is widely discussed as well [15, 21, 28].

Information and Communication Technology (ICT), accompanied by intelligence have widely spread in all the spheres in business, sport, leisure, transport and energy systems. Computer and information technologies have also been deeply involved into our personal lives. Our cars, equipment and electronic devices are becoming more and more computerized. Of special interest is the personal computer (PC) that was the first step and the biggest invention in the electronic world [5]. Technology changes the existing and helps the evolvement of new business models and trends. One can easily observe that nowadays the concept of technology supports societies and it is a fact that societies adapt to the new arising technological trends. All this is a proof how deep information technologies are integrated in the way we live, play, study, think, work and entertain ourselves. It gives a completely new direction for practising innovation and creativity. It is even possible to conclude that it is an essential part of human lives.

The contemporary society moves towards computerization everywhere and therefore modern business and economic models are realized by the implementation of advanced information technologies such as on-line databases, subsystems, interconnected devices, digital assets, Internet of Things, converged networks and others. In this respect in developing social systems by implementing modern information technologies the following benefits could be achieved:

First - saving time by providing authorized access to the central location for efficient searches of valuable historical and real-time data, thus enabling the capacity to learn and solve problems quickly.

Second - helps to reduce or avoid costs by providing information on success stories that may be implemented or mistakes that may be avoided.

Third - expands the information network: provides information sharing opportunities by connecting with other websites, digital devices, “experts” or people doing a similar activity.

Forth - provides information on other information, for example, conferences, workshops. Digital devices connected via the Internet, produce a large quantity of data. And all this information can be transformed into knowledge. Around the world, the potential of smart systems is highlighted to facilitate sustainable development, economic growth, societal progress and improved efficiency [5].

On the other hand, devices and information technologies are implemented in the different spheres of the society. In this way, there is a kind of control by the person onto the external environment [27].

There are different companies on the market that implement projects for building capabilities for a sustainable society. For example, the possibility of building a structure of integrated intelligent systems and a comparison between the different stages can be observed in the stages of the company's infrastructure development [27]. In order to achieve efficiency, reliability, flexibility, resilience and adjustability at each stage of the infrastructure development a new infrastructure domain should be developed. For example, the first domain could be the domain of local infrastructure, then the domain of semi – automated infrastructure could be developed, later a domain of intelligent infrastructure and in the end a domain of the fully integrated intelligent infrastructure. The development and joint functioning of these infrastructure domains in real time is connected with the usage of different scientific approaches and concepts. Analyses of the objectives of the projects show that companies make efforts to apply a comprehensive approach in order to build a common integrated urban and industrial informational infrastructure and a common information environment. For its successful functioning and information interoperability, it is necessary the platforms that build the informational domains to use unified standards and protocols, internal and external interoperability profiles as well as unified software products and software interfaces. For this purpose an architectural approach concept could be applied for architectural configuration of the informational infrastructure. The architectural approach is connected with the building of system and technological views that are at the base of developing the system design of the platforms (end devices - computers, laptops, smart phones, servers, intermediary devices and others) that are functioning in the local and the remote area of the informational infrastructure. The system design is related to the building of the technical and software configuration of the platforms and the needed information services. On the other side, services are connected with the realization of the different functional configurations, for example terminals, workstations, servers, systems of sensors and others.

To get an overview how information technology has affected urban, economic and social features, we will look into some real-world solutions provided by IBM – one of the pioneers in ICT development [12, 31].

For the last decades, there is a rapid acceleration in urbanization. Many of the city inhabitants drive cars, and the products consumed by them arrive in trucks. There is a constant flow of moving vehicles. However, the traditional infrastructure and management approaches cannot handle the world`s traffic. And the solution to this issue is not by focusing on separate decisions of the problem. Instead, the key lies in the focus on the whole system. We need to look at the relationship between the entire system and all the other systems that are affected like supply chains, environment, companies and others. Traffic is not just a line, of course, it is more than that.

At the same time, we have a range of advanced technologies that can help solving the issue. Nowadays, there are infused sensors and devices into streets, bridges, interconnections, signs, signals, tools. Basically, parts of them comprise transportation systems aiming to cut down traffic jams, reduce hazardous emissions and improve public transportation. Cities like San Francisco, Amsterdam and Seoul participate in the common initiative Connected Urban

Development. The information and communication technologies that are implemented are as follows:

- tracking of vehicles or systems of identification;
- programs for traffic jam management;
- video-communication solutions;
- integrated systems for transport management;
- GPS, RFID and other sensor technologies;
- using broadband Internet, wireless access to the smart infrastructure;
- communication technologies for creating a modern working environment.

For that reason, these new traffic systems, when interconnected comprise "traffic intelligence" that can improve drivers' commutes, give better information to city planners, increase the productivity of businesses and raise citizens' quality of life. They can also reduce congestion, shrink fuel use and reduce global carbon emissions.

Another area where smart solutions can be provided to increase process optimization and sustainability by building intelligence into our entire retail system are retailers, manufacturers, and suppliers. For example, the German Metro Group, one of the largest and most international retailing companies in the world, has introduced Radio Frequency Identification Technology [16]. It is widely used in the logistic systems and smart food systems because it makes it possible to supervise the commodities in the supply chain.

The existing technology also helps to capture and process all the data gathered from information devices, and turns it not just into organized information or knowledge, but actual intelligence. For example, smart healthcare systems can lower the cost of therapy by as much as 90%. Smart systems help confirm the authenticity of pharmaceuticals and the security of currency exchanges as well.

These advancements have already affected urban, economic and social features, resulting in knowledge creation and innovation towards developing a more efficient, integrated and a sustainably-functioning society.

Analyses of the information technologies development from the one hand and the increased need for more services to be implemented to build a sustainable society, on the other hand, show that the implementation of information technologies, particularly, the IoT concept could ensure that increased demand. That is why in the next point we will discuss solutions and examples of applications of the Internet of Things and the Internet of Everything concepts as an information technology tool for building smart cities, which is crucial for building a sustainable society.

4. Implementation of Information Technologies and the Internet of Things concept for building "smart cities"

The technological development of a "smart city" is achieved by building equipment and infrastructure [22].

An example of the application of the IoT concept as part of ICT technologies for building smart cities is the one that is being implemented in Barcelona, Spain. The city's vision for a smart city includes both technology and efficiency-oriented targets, and human capital advancement through development [2]. The city's high-tech area puts forward futuristic images of "smart" regarding technology and design in Barcelona with a large scale collaboration and knowledge exchange among the city's people as well as businesses' advance [3]. There is $3B value creation in the projects of smart lightning, smart buses, smart water, smart bus stops, smart parkings, smart waste. As a consequence, this leads to 4 500 new companies, 56 200 new jobs [23]. From the evaluation framework applied to both cities,

Barcelona and Valencia savings in energy are minimal from an urban perspective because the whole system is small. However, if the system could be scaled, then the potential benefits are higher. Similar things happen with external savings of approximately two tons of carbon emissions per year that could be saved using this solution. The values are discrete, but the measure has a clear potential for reducing the impact on citizens [25].

Another worthy-of-mention example is the driverless trains in Paris [27]. Apart from it, a virtual power plant is provided by Siemens in Munich.

A fascinating project worth to be mentioned is the Songdo International Business District (Songdo IBD). This 10-year development project is estimated to cost more than $35 billion, making it one of the most expensive development projects ever undertaken. Songdo IBD is planned for the people who live and work there. It is a city of perfect harmony that matches the ideal combination of residential, cultural, business, retail, and recreational environments [32].

The most integrated of the current approaches for smart and intelligent cities are based on promoting and building intelligent infrastructure. Integrated smart city strategies help urban citizens become more informed, participatory and networked than ever. They help businesses become innovative, productive and agile. They forge an entire sphere of intelligence and sustainability. In essence, integrated smart city strategies aim to connect the physical space of cities with the economic and social sphere – a connection that although clearly existing, has always been trouble for scientists and policy makers.

It is obvious that information technology alongside the intelligent strive towards innovation and a more integrated smart city image, brings about a fundamental transformation of the smart city notion. With the advance of information and communication technology, both demand and the need for its adoption is generated.

To sum up, the integrated model of the smart city in general works toward the following assets:

- progress of human capital: citizen empowerment (informed, educated, and participatory citizens), intellectual capital and knowledge creation;
- advance of social capital: social sustainability and digital inclusion;
- change of behaviour: sense of meaning (i.e. the feeling that we are all owners and equally responsible for our city);
- user-friendly approach: technology responsive to needs, skills and interests of users, respecting their diversity and individuality.

The project "Connected Bus" is developed by Cisco Internet Business Solutions Group (IBSG) and includes technologies and application software that could be implemented in all types of transport, including trains and taxis. The prototype of the 'Green Bus', developed by Cisco and Transport Municipality Department of San Francisco, do show how the public transport could be more ecological. There is a mobile access to the Internet in the bus so passengers could work while they travel. In addition, the software application that uses GPS delivers actual information for transport itinerary and connections to other transport lines. On the specialized displays there is information for the saved hazardous emissions in the public transport. Also, the automation information system reduces the harmful influence by optimization of transport schedules [10].

The possibility to trace, sustain and exchange the information among different area networks is only possible if interoperability is achieved at application level [4]. It could be concluded that the benefits of "smart cities" are sustainability and efficiency.

5. Conclusion

While moving to a global integrated economy and community we face a huge challenge – but it also opens greater opportunities. The world is losing some of its size because we use information technologies, but the more important fact is that it is getting smarter. Nowadays all items, systems and processes can be linked, connected to one another and some intelligence could be loaded on them.

Today buildings consume about forty percent of the world energy. In addition, due to the fast growth of the cities, the need to exchange and modernize the old urban infrastructure is a primary mission. In Europe alone, ninety-five percent of the power is consumed by installations that were built in the twentieth century [27]. Modernizing existing buildings and making them more efficient, integrated, and "smart" will meet the challenges in the cities in the field of ecology, transport and habitation policy.

There is a tremendous demand for a positive change in the world, regarding the optimization of the infrastructure and the operation of processes engaged with it. With the presence of the advanced technology and its continuous development, in the twenty-first century, we definitely possess the resources to do so. In this paper it was explored what it means to make the systems by which our world works, work better and more efficiently – in relation to energy, medicine, food, water, supply-chains, roads, cities, everything. With the great range of resources, expertise, and experience, governments, enterprises and institutions of all sizes on a global scale can be ensured with these tools, corresponding to the pioneers in the area, to build a planet operating with intelligent information systems. It has been proved that when we use smart systems it has a significant difference to the prosperity of the world economy, the sustainability of the Earth and the healthy state of the society on the globe.

Information technologies have taken us a long way in the past fifty years. But seizing the opportunities before us will depend on more than intelligent systems. It will depend on spreading intelligence across our technology infrastructures to build a sustainably-functioning social community. This paper could provoke further research, analysis, and thoughts in the fields of implementation of constantly developing information technologies in our life – health, finance, education, sports, leisure and other spheres. A very sophisticated problem for future research is the development of integrated informational environment and common operational infrastructure. It will allow the unification of different domains and the achievement of interoperability and a possibility to exchange real-time information between different smart city domains as well as between domains provided by different vendors. One very important aspect of the further study is IoE security issues because the IoE is a subject to the same security risks and vulnerabilities as traditional local area networks and computer systems. A great concern is the potential to cause physical damage and harm to individuals and property. The reason is that everything that is connected to the Internet is hackable and there is a real danger to hack into a self-driving automobile's built-in telematics unit, the control of the vehicle's engine that can cause a crash, to take control over airplane navigation systems and manipulate the data, or to access computerized health equipment, change the settings so they can be harmful to the patient [26]. The future developments of IoE security issues are so important as the building of the smart urban infrastructure is. Concerned about the privacy of data, especially because in various parts of the world there are different legislation and standards, especially the security of data and hacking, it is necessary to deal with the political aspect, with the civil aspect, and with the technological aspect. Another suggestion for future research is to unify the efforts in the area of sharing experience in building different aspects or solutions for smart cities. A possible future project that could be developed is an online platform with associated data base for lessons-learned in the area of the specific applications

of information technologies. This will facilitate the efforts of the companies that participate in the development of IT smart city solutions in order to build a sustainable society.

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Application of GIS Technology in Crisis Management

Georgi Pavlov[1], Juliana Karakaneva[2]

[1] University of National and World Economy, Sofia, Bulgaria
gpavlov@e-dnrs.org

[2] NBU, Sofia, Bulgaria
ykarakaneva@nbu.bg

Abstract. The report treats issues related to preparation for responding to crises of a different nature. The stages of preparation and character of the training are discussed. The interconnection and interdependence lead to highly probable unpredictability, so it is important the transition from event-driven management to preventative crisis management of critical infrastructure. The authors offer the technological tools in this area.

Keywords. Crisis management, GIS, critical infrastructure, decision making.

1. Foundation

Natural and technological risks and disasters that occur on the territory of the Republic of Bulgaria and in the world, lead to the necessity of observations, research, simulations and analyses. These activities contribute to the formation of a comprehensive concept about the consequences of an emergency situation.

The report considers the modern methods and tools for modeling and analysis, based on intelligent geographic information systems [1, 2]. The goal is to outline tasks for the development of scientific activities in this direction.

Information, technical, natural, political, corporate, regulatory, legal, social, economic, etc., etc. – crises affect all spheres of public life. In fact, they are a natural stage of the organizations' development. They create a sense of chaos and impose making quick decisions in the lack of time [3]. Increasing the number of emergencies of different nature over the past decades gives proof of their thorough examination.

In fact, the crisis is a serious threat affecting the structure, values, or fundamental norms of a social system, a threat that in a situation of strong tension and high uncertainty requires making the important decisions. The crisis is the decisive moment, a turning point in functioning of every organization. It is a time when are tested the capabilities of the system to adapt to the new conditions, to overcome the negative effects and to continue to successfully carry out their functions. The process consists of three main aspects: analysis, evaluation and management.

To meet the challenges of the crisis, the scientists create different discussion forums, conferences and centers where to share experiences and build the models and techniques to counter emergencies related to natural disasters, industrial accidents, financial crises, product failures, etc. The violation of the functions of critical infrastructure (CI) inevitably led to an abrupt and significant deterioration the quality of life. There may be serious consequences for the business management of the population, the environment, the rights and freedoms of citizens, and security.

Example. We consider an accident on one of the many streets in a big city and the traffic stop. It's not a problem, 20 meters further down there's another street, so that the crash is minor inconvenience. The inability to function there is a sphere of influence with a radius of 20 m.

At CI the problems are not so simple, because its components are interconnected and mutually dependent. It is often impossible or economically inefficient to duplicate infrastructure networks. In addition, useful and sought-after synergetic effects (or economies of scope) in the infrastructure often cause the Domino effects in case of an accident.

For example, if parallel to the pipeline network, the administration built an optical (economy of scale) network, then the incident in gas supply network will break the optical communication.

The interconnectivity and interdependence of CI components lead to severe and difficult to predict consequences on the large territories and in a variety of sectors. Therefore, for the purposes of an effective critical infrastructure protection (CIP), decision makers need to know every detail of the infrastructure system and to be able to see the whole picture. They must have all available information to be linked to the geographical location of the objects. This is just the beginning – there is a need of powerful software to process in real time the incoming data, perform simulations and forecasts, provides an opportunity for information sharing between all interested parties.

The modern intelligent GIS are the only solution that meets all these requirements, and there is no reason to doubt that it can cope with new challenges. Without GIS we cannot talk seriously about CIP.

2. The Importance of Being Prepared. Aspects.

The interconnection and interdependence between the events in crisis leads to the lack of predictability, so it is important the transition from the management, based on the events (event-driven management) to preventive management (preventive management) of critical infrastructure.

For example, as a result of an accident, dangerous chemicals from the refinery could contaminate drinking water in a nearby reservoir. These seemingly independent critical assets in terms of economic sectors are actually dependent on the basis of their geographical location.

Geographical Information System (GIS) can help, by giving visual and spatial oriented information about the vulnerability of different infrastructure objects as power station, bridges, banks or transmission lines. Using this information, you can build an accurate geographical based model representing the probability for the damaging consequences and cascading effects due to vulnerability and interconnection. You can play simulations to calculate the probability of success in the various action plans. If you have powerful simulation software, which also is a Web-based, will significantly increase the speed of testing out various operations. Professionals in the system of critical infrastructure protection (CIP) will be facilitated in the invention of new ones and will be able to share new information.

All of these activities are elements of preventive management, which support the limitation of the unpleasant surprises when the incident occurred. Preconditioning action and accumulation of information enables you to make informed decisions in a crisis. The benefits are – operational procedures, higher effectiveness and efficiency, reduction of direct and indirect costs. The mitigation of the accident and the recovery of vital services will be much easier and will be achieved more quickly.

CIP often means reducing the critical attitude by increasing the alternative opportunities and resilience. *Example*. A train line is blocked and the composition, loaded with gasoline for a small town is stopped. As a result, the supplies for the day may not be realized. Considering the probability of such an event, you can compile a geographical based model that visually presents the alternative of this railroad. This might be another line, which is currently scheduled to run a passenger train. If there is no other option, could stop the passenger train and to pass the composition with gasoline. In this case, the costs caused by the sudden slowing of the rate of passenger train, will be significantly lower than the cost of the interruption of supplies of gasoline. This may not be the only option, but the study of the various options and analysis of costs and benefits requires time, which GIS saves by optimizing the process.

It is important to know, for example, whether alternative railway infrastructure can withstand the load of the train, loaded with thick liquid mass of gas. Thanks to the GIS software, with just one click on any geographical object, the operator may obtain all information about it.

Another example. If an important avenue in the city is blocked, GIS provides the visual picture, including a bypass routes and can they take the traffic on the avenue. If it is not possible, the traffic can be prioritized, such as most direct alternative routes to nearby hospital/police/fire to be reserved only for cars with a special regime of movement. This will avoid a deepening problem, reflected in the violation of the functions of these centers. The tool will reduce the interconnections of critical infrastructure components "an important avenue" and "hospital/police/fire".

GIS tools can manage huge arrays of data in real time, which will illustrate how far are the congestions, where on the road network and with what time tolerance can be placed traffic cops anywhere to deviate the movement, etc. The system can use visual data from cameras, historical traffic data on different roads at different times of day, etc.

Sharing of information. CI is a private and public property. Usually the critical assets, even in one industry have a different status of the property. In Bulgaria, for example, a power plant may be a private enterprise, while a power line is public property, which in this case is part of the structure of the NEC. GIS allows immediate information sharing between owners/operators of the CI, regardless of whether they are public bodies or private companies.

Early response. Technological, environmental or terrorist incidents usually don't just happen, but any geographical defined processes always precede them. Early detection of dangerous development is an essential part of the CIP. GIS works with data from detectors of motion, metal, infrared rays and vibration or weather phenomena. In combination with an accurate map these data make it possible to detect a nascent incident. The researchers can identify potential risks by simulation method "what would have happened if ...".

In addition, at the event of a real disaster, which is irrelevant to the CI in the time of occurrence, it is important to restrict the effects of the crash to the critical asset in the vicinity. We need to know the speed of propagation of the effect, the geographical location of critical assets and the pros and cons of the area in terms of slowing down the action of the effect on the assets. Mobile GIS applications such as ESRI's ArcPad, allow sending of accurate and up-to-date information from the location of the events to the GIS platform.

CIP has several stages, which we arrange chronologically according to the incident. Three of them follow it – the stages: reaction, mitigation and recovery. In these three stages it is very important to prevent panic, the public to be informed of how responsible organizations deal with the problem. So the economy will not suffer additional damage which can be avoided, and can provide timely necessary resources where need. GIS can

help in this respect by providing the media with visual picture in real time for the operations performed (or through digital signage technology – to large groups of people).

3. Functionalities of GIS

The main function of GIS is processing of digital information and creation of digital topographic map.

1) Map design. The technical aspects in the cartographic modeling and design for creating topographic maps are:

- processing of raster images;
- creation and editing of linear and point objects;
- creating and editing texts;
- specific tools:
  - create and use symbols (the opportunity to compose the character libraries that can be used in other projects);
  - create templates of curves. (the opportunity to record these templates into separate files, for further use);
  - management of priority of automatic crossings and in drawing;
  - automatic creation of bridges;
  - keep the curves in a hierarchical system of layers;
  - lock/unlock all curves in a layer.
- show/hide all text in a layer;
- creation automatically the mathematical basis of maps in different coordinate systems, projections and elipsoidi ("Gauss-Krüger, UTM, WGS84, etc.);
- generate frame and layout, in accordance with the relevant standard;
- include automatically the river and road network;
- generation automatically of area symbols;
- generation automatically the districts of settlements.

2) Print preparation includes:

- generate PostScript output files;
- color separation;
- determining the scale of printing;
- preview the result.

3) Output of the information. The information can be imported and exported in various vector and raster formats, more common of which are: • TIFF; • EPS; • DXF; • Arc/INFO coverages (. e00); • ArcView (*.shp); • MapInfo (*.mif/*.mid); • Micro Station (UR*.dgn).

4) Encoding of information. The encoding of objects is made by generating a 5-digit numeric code, which is obtained on the basis of the table of symbols for the corresponding scale. There is a filter for recoding of digital information to the standard for the exchange of digital geographic information DIGEST.

5) Structuring the information. Every graphical element is placed into a separate layer with a name corresponding to the code of the item. The end product from the processing of digital information in topographic software for editing is:

- map originals ready for printing;
- encoded, structured and free of errors information, allowing processing and analysis in the GIS environment.

The rational consequence of implementing this technology is structured, encoded, stripped of geometrical, topological and attributive errors digital information about the

area. The possibilities for using this information are endless. Currently are created and maintained in good standing the following digital geographic products:

- database of objects from the area in m 1:25 000 DB-25 (vector format) (fig. 1);
- database of sites of locality in the 1:250 000 DB-250 (vector format) (fig. 2);
- digital terrain data of the area (matrix format).

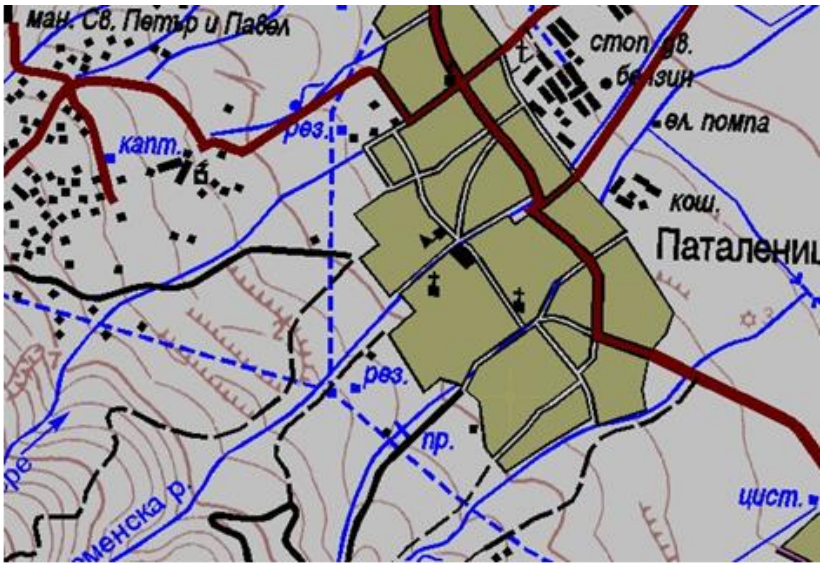

Fig. 1

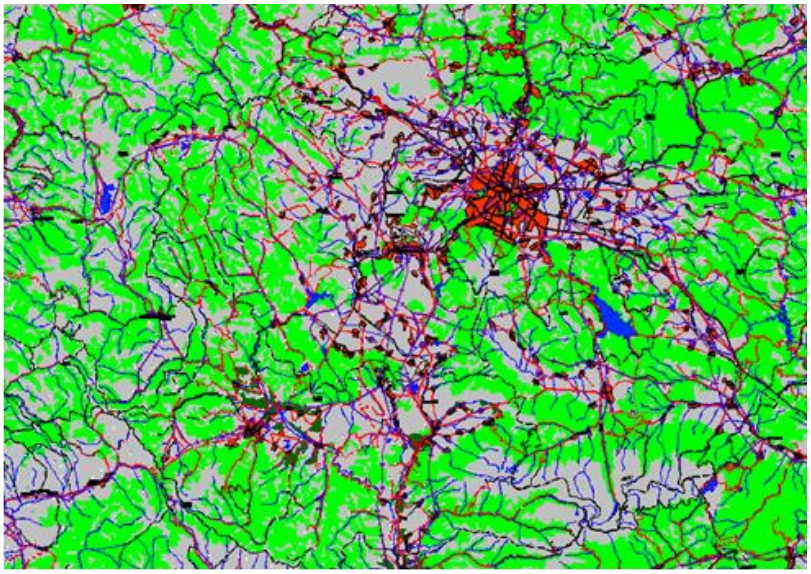

Fig. 2

The output data are digitized horizontals of topographic maps in scale 1:25 000, used for the creation of the following databases:

TERRA 1 – data model is a matrix with cell 3"(approximately 100 m);

TERRA 2 – data model is a matrix with box 1"(approximately 30 m).

4. GIS features [4, 5]

Measurement in real time using GNSS. GNSS (Global Navigation Satellite System) provides new methods that facilitate the working and business processes in many telecommunications companies, which have sites of their infrastructure of a specific place. The networks using this technology include a number of basic ground-based stations that are interconnected and receive geospatial data from satellite systems. The received information is transmitted to the control center, where it is distributed, stored, analyzed and made available to end users as services. The access to them can be made in real time, via the Internet or mobile phone and thus can be performed online administration and easy control in dealing with the data. The main advantage of GNSS networks is their accuracy. The principle of operation of satellite navigation systems is based on the measurement of the distance from the object to the satellites, whose location is known with high precision.

GIS in WEB-space. Web based GIS services can be published and are accessible via the Internet as stand-alone applications. They can be part of the Web site, portal or business application and the end user can be anywhere in the world, and can submit a query with an ordinary Internet browser. Web-based GIS offers many opportunities for access to specific information by means of client-server architecture and similar services provide all of the features of the typical information systems, including the collection, storage, retrieval, analysis and visualization of data. Thanks to the Internet location of GIS, the companies reduce the costs for the implementation of personal server in the company and efforts for the creation and maintenance of specific databases. That's why Web GIS is a cheap and easy way to distribute geospatial data and tools for managing processes. GIS services allow providers to make their GIS databases easily accessible through a Web browser and deployment of public Web sites do not open extra holes in the information protection.

Cloud computing. The cloud infrastructure offers easy adjustment, convenient operation and the absence of preliminary expenditure typical of traditional GIS, such as hardware, software, licenses, etc. Further centralized GIS cloud systems can provide encrypted connections to their consumers and contrary to many fears about the security of company data, privacy could be much better protected. They should be better insulated from the environment compared with the systems who work on computers at the offices of the organization. The practice shows that the main reason for the problems with information security is actually in humans. Unprofessional attitude of personnel leads to exchange of GIS data via unsecured email. In principle, centralized storage and protection in the cloud eliminates the human factor in information security. However, if managers could not overcome the fear to delegate the management and storage of GIS information to an external provider, GIS-server can be located in your own data center, and staff to access the projects from anywhere in the world via their mobile devices.

5. Conclusions

The use of GIS technology in crisis management has no an alternative. GIS provides an integrated approach of access to geographical and georeferenced data. But GIS is not only a data warehouse. It includes many intelligent tools for information processing and

analysis. GIS helps responsible local staff to draw up plans for disaster management and make it available to the relevant authorities.

There are several solutions:

• Web-based access to data. These GIS gather information from many sources on the Internet (like GOOGLE EARTH);

• GIS as an opportunity to integrate the data. Very often the administration and public-private organizations develop and maintain duplicate databases. The organizations may use these databases in a corporate environment;

• GIS is a means to support decision-making. In the event of a disaster GIS tools can perform in-depth analysis and provide alternative solutions.

Acknowledgment

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A Place of GIS Technologies in Information Systems for Crisis Prevention

Georgi Pavlov[1], Alexander Kolev[2]

[1] University of National and World Economy, Sofia, Bulgaria
gpavlov@unwe.bg

[2] Bulgarian Defence Institute, Sofia, Bulgaria
a.kolev@di.mod.bg

Abstract. The paper reviews a common methodology of systems for crisis prevention, pointing at critical infrastructure protection. The advantages of specialized GIS software are analyzed as part of an information system for crisis prevention. A system architecture software solution based on specialized expansion modules for input, processing and network provide input for computer simulation environment is proposed.

Keywords. Crisis prevention, critical infrastructure, GIS, computer simulation.

1. Introduction

Making the steady potential to resist against some low intensity conflicts and disasters is a very liable task, reasoning human health protection and infrastructure objects guarding. In solving these tasks are involved powerful state structures and organizations. A key point in their activities is the perfect preliminary organization, engaging equipment and personnel. In this tendency, it is necessary to attract all possible resources, including powerful information technologies.

In intentions of this paper are analyzing of the advantages of a specialized GIS (Geographical Information Systems) software solution and clarification of its modules in crisis prevention information systems building. The authors makes attempt to enter deeply into decision making chain during anti-crisis operation and regarding this to disclosure full GIS technology capabilities.

The keystones of the material are the crisis prevention and critical infrastructure information system architecture, GIS technology as a part of the crisis prevention architecture, extended techniques for functionality improvement.

2. Crisis Prevention and Critical Infrastructure System Architecture

In the root of the reviewed by authors crisis prevention and critical infrastructure system architecture is the well known OODA (Observe Orient Decide Act) loop. The OODA loop, originally introduced for military demands, now is often applied to many human activities as business and commercial operations, learning process and much more. The keywords of its all applications are velocity and quality of the produced decisions. In the discussed case for expressing the place of specialized GIS, the authors will pay more attention to first three steps of the decision-making loop, namely observe, orient and decide. There is assumed, that all personnel activities are made in defined in a particular space, target critical infrastructure, which has own features. On the other hand, the GIS technology is inherent to process not only

geographic and geo-referenced features, in addition there are much powerful functionality, designed to collect, analyze and share structured data.

At the first stage of observing the OODA loop, the significant moments are sensor data collection and geographic data manipulation, as shown at Fig. 1.

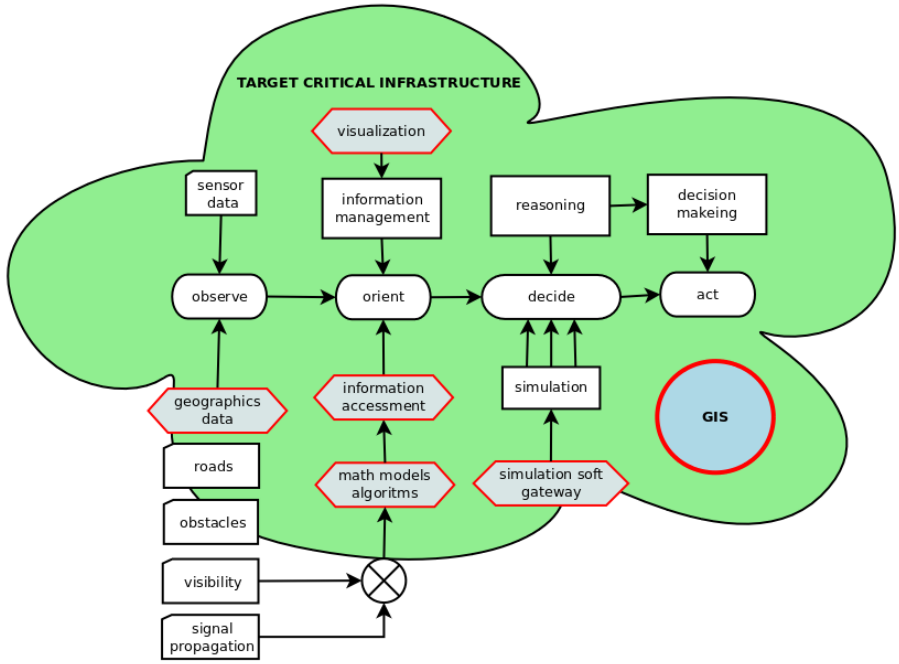

Fig.1. OODA loop over target critical infrastructure

As a minimum required geographic data collection is restricted to roads and possibly obstacles, but there may be much more specific regional features as landslides, fluid zones, referenced accelerations in earthquakes and others. In most cases, determining the visibility and signal propagation is important. These are complex analysis and take a place not only at observe stage, but also in the next, orient stage of the decision-making loop.

The second, orient phase is dedicated to information management and assessment. The typical GIS function of supporting has its visualization as Common Operational Picture (COP), but more powerful utility is the information assessment, which is based on a mathematical models and algorithms.

The decide phase may be pointed as the most responsible regarding decision-making loop. At this stage there is often a necessity of applying a simulation technique in case variations of possible solutions to be produced. Taking into account, that the simulation software tools are separate subsystem, in this case our GIS platform will be usable as a data source for the simulations. As a common usable style to interchange data for simulation purposes are Distributed Interactive Simulation (DIS) and Hight Level Architecture (HLA) standardized protocols [1]. This last feature is not a typical GIS function, but may be implemented by using powerful extension making abilities of the referred bellow flexible software. And so, the personnel will be assisted in reasoning task, substantiating on a few possible variants to perform an action.

Presented here reasoning of the GIS place in crisis prevention, leads to the conclusion that some of the above described performed tasks are not able to be implemented by using the most common GIS configuration. This raises the question of introducing GIS advanced functionality.

3. Native and Advanced Functionality in GIS Software

In the discussion bellow the authors rely on one of the popular products from the area of a specialized GIS software tools, named Quantum GIS (QGIS).

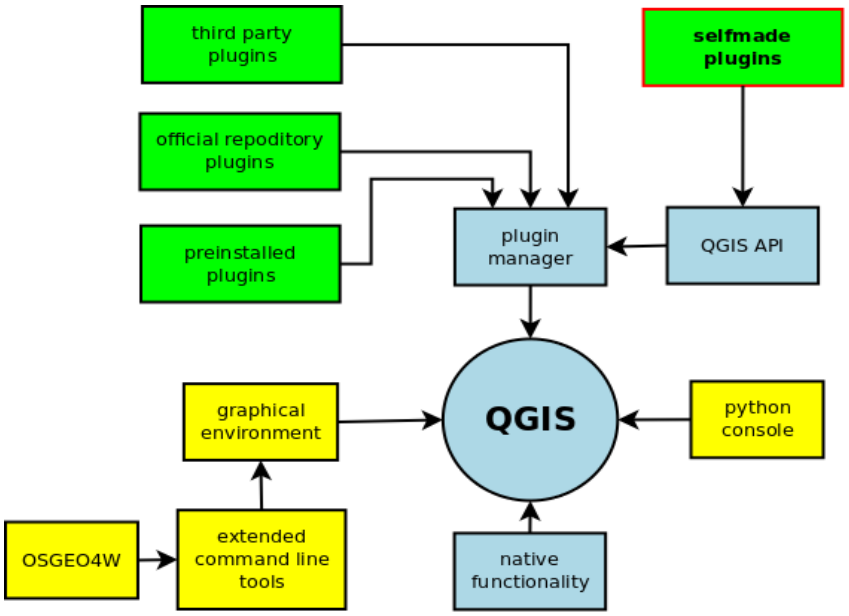

Fig. 2. Quantum GIS extended modules

QGIS is a cross-platform free and open-source desktop software application. Similar to the other GIS tools, this software allows users to provide geographical and table data viewing, editing and analyzing. For the purposes of our examination is useful to present the "ecosystem" of the typical and extended module system, shown at Fig. 2.

With native functionality are presented all built-in techniques which are used by most users in their daily activities. In case it is necessary to apply a tool with a specialized not often used focus, there are available command line tools, based on OSGEO principles.

The Open Source Geospatial Foundation (OSGEO) is a non-profit organization and was created to support the collaborative development of open source geospatial software and promote its widespread use [3]. The existing Windows OS version of this tools suite is abbreviated as OSGEO4W. In addition to the above described, an OSGEO tools are developed in close cooperation with Open Geospatial Consortium (OGC) [2], which ensures full maintenance of professional and industry standards according to GIS technology. Additionally to their user-friendly interface, the developers of a QGIS are provided with a graphical environment and python programming language console to use with these extended command line tools.

Another usable mean for advanced functionality gaining in QGIS ecosystem is a wide extended system, based on plugin development and deploying. Among the native functions in QGIS distribution is situated a plugin manager tool. This tool is intended to carry off, install and activate/deactivate small, but usable in certain cases, program modules, also named plugins. With plugin manager the user who has advanced skills can preview a list of all installed plugins with their short description and instructions for use. From the same installed plugin list the user can activate or deactivate some of them. In this list persist only belonging in distribution, or preinstalled plugins.

Another way for obtaining different plugin is to automatically download and install it from QGIS official plugin repository. In the same plugin manager form exists the possibility to enter more than one plugin repository, in many cases this is officially recommended, or from approved by QGIS developers third party creators.

But what to do when searching of required is not satisfied? It is certainly in the case when our GIS platform is expected to prepare data and communication on specific protocols as DIS and/or HLA towards simulation subsystem, close to crisis prevention theme. In this very specific case, the decision has its own development on a requited functional extension, or self made plugin possibilities.

4. Development scheme for a GIS plugin extension in the interest of crisis prevention

The most powerful way to develop a needed extended functionality is to produce your own QGIS plugin. To proceed to that ultimate option is necessary, of course, in case of complete depletion of already discussed options for functional extension. Graphically, discussed development scheme may be seen at Fig. 3.

All the tasks about building a work environment for this software development initiative consists of installation of primary and secondary software tools. The needed tools are described below as:

QGIS – a stable version of the main specialized software;

Python – a stable version of the scripting programming language interpreter;

Plugin builder – secondary software tool, will be installed in the QGIS environment by the internal plugin manager;

PyQT4 – rapid application development environment for multiplatform application development, attended to use of a Python scripting language;

SciTe – a text processing tool, suitable for Python programming;

GNU Make – a secondary software tool, usable for program code execution preparing;

Plugin reloader – a secondary software tool, installed in QGIS environment as a plugin.

The first step is a base plugin creation by Plugin builder. In the QGIS environment using convenient interface the user introduce a name, description, version number and other non-mandatory information about the new constructed plugin. Running the execution of the Plugin builder creates a folder in the local file system with new plugin name and sub-tree with template files reasoning Python software project.

Next step must be performing the tasks for creating and compiling user interface and program resources. Very usable user interface creation is QT Designer, part of PyQT4 rapid application development environment. The result of applying QT Designer is a text file in XML format. The compiling of the user interface and the program resources is made by running of a predefined command scripts. These steps are very usable to automate and there comes to aid GNU Make tool. In the discussed cases applying of the GNU Make is a made

easier, because at the first step above, the Plugin builder has created a necessary configuration file.

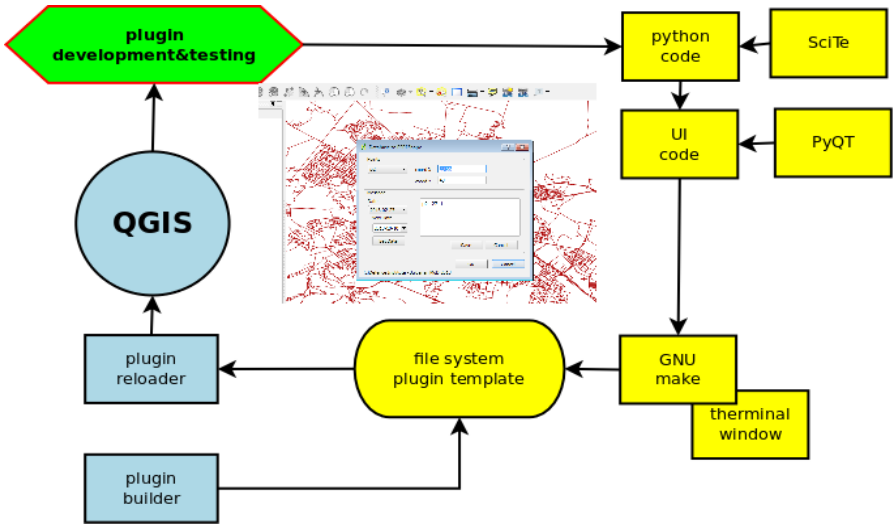

Fig. 3. Development scheme for a QGIS plugin extension

Adding of functional classes in the program software code is the most important stage of the new plugin development process. At the first step the Plugin builder has created a minimal program fragment for initiating and loading a very simple program interface. For viewing and editing of the script program code comes to help a specialized text editor SciTe. There the developer realizes necessary data structures and codes algorithms width by usage of available python modules and very important software libraries from the QGIS Python application program interface. At this step is possible and recommended to implement a unique non GIS functionality as DIS/HLA data interchange protocol support. The last thing is essential in terms of crisis prevention theme.

In the procedure of testing and modifying a developed functional extension is needed multiple reinstalling and reloading new developed plugin. To avoid a routine work-flow, at this step is useful to use Plugin reloader tool. With a Plugin reloader the dedicated plugin is reinstalled and reloaded automatically by key combination.

5. Conclusion

The discussed topics in this paper show that the GIS technology is a substantial part of crisis prevention and critical infrastructure protection. It was paid attention to the intrinsic functionality of the typical GIS application; additionally possibilities to achieve enhanced special features were analyzed. Here was indicated by the authors, that important approach to make work together a particular software branches as geoinformatics and simulations is achievable. In support of foregoing, here was brought the detailed description of all needed tools and development process chain.

The other conclusion is that the discussed technology is versatile and highly customizable to meet a wide range of requirements.

Well known GIS tools and availability of skills to develop extended functionality is a good base to build new important possibilities and meet new challenges in regard to crisis prevention and critical infrastructure protection.

Acknowledgment

The author express their gratitude to the Bulgarian National Science Fund for the partial financial support under the Grant № DFNI-I02/15 from 12.12.2014, titled "Information System for Integrated Risk Assessment from Natural Disasters".

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Application of the Analytic Hierarchy Process in Expert Evaluation and Prioritisation of the Natural Disasters Risks

Tsvetan Tsvetkov

UNWE, Sofia, Bulgaria
ttsvetkov@unwe.bg

Abstract. The report accepts the assumption that it is not possible to use the same approach to all natural disasters risks in a region. In order to manage the risks, it is necessary to evaluate and prioritize them. The priority of each risk depends on the probability of the risk event and the negative effects (damage, injury), in case the event occurs. The author proposes a model for assessment of natural disasters risks on the basis of collecting the necessary empirical data and aggregation of experts' opinions. The popular model of Thomas Saaty – Analytic Hierarchy Process (AHP) is used. For the purpose of the study, an Excel based model is developed. It helps to collect experts' opinions, performs the necessary calculations, and gives results in numerical and graphical form. The consistency between experts' views can be calculated. Based on these results, it is possible to make conclusions and proposals for protection from natural disasters, as well as crisis management.

Keywords. Natural disasters, Risk, Risk management, Analytic Hierarchy Process, Prioritisation.

1. Risk management and natural disasters risks management

Business practice and public institutions have established the application of risk management as a reliable approach. The widely adopted risk management standard ISO 31000 defines risk management as coordinated activities to direct and control an organization with regard to risk [1].

From practical point of view, risk management can be tackled as a system of targeted actions to cope with the risks emerging from the functioning of a particular system. From this perspective, the most significant elements of risk management are: identification, analysis, assessment and dealing with the risk. In addition, there are risk planning and risk monitoring.

Identifying the risks of natural disasters requires defining a list of risk events, which if true will cause certain damage. Scientific literature does not offer a single definition on the risk concept. Most often, authors share several different viewpoints. On the one hand, risk may be perceived as a set of factors that hamper accomplishing the objectives of the organization. In other words, before identifying the risks of natural disasters the organisation should have established a system of goals. Such organizations, for example, could be district administrations or municipalities.

On the other hand, risk could be perceived as a random event whose occurrence would have negative effect on the organization objectives. From this perspective, risks can be evaluated using two criteria – the likelihood of the event to happen, and the scale of the negative effect if it occurs. These two factors may be assessed by objective methods (e.g. by statistical analysis of already occurring events) or subjectively, through expertise. Concurrent evaluation of these factors makes it possible to assess the level of risk of this event and consequently – its priority.

The idea behind the model, subject to consideration in this publication, is to evaluate the risks of natural disasters in a particular region regarding their likelihood to occur and damage. The aim is to provide not quantitative (such as probability of occurrence), but qualitative assessments based on the comparison of the characteristics of each disaster. The logic of the relevant standard [1] can be used in the evaluation process.

2. Analytic Hierarchy Process Application

Methods of expertise are flexible and widely applicable tools. They can be used in most of the risk management functions – risk identification, qualitative assessment and to a certain extent – quantitative risk assessment, identification and evaluation of alternatives to counteract risks. These methods do not require significant resources and time. At the same time, it shall be considered that the seeming ease to apply some of them can be strongly misleading. The application of methods, without complying with all requirements, can result in fictitious accurate results, which might lead to wrong conclusions and decisions.

This publication suggests that the expert assessment of the natural disasters risks in a region and their prioritization be carried out through the so-called Analytic Hierarchy Process formulated and described by T. Saaty and K. Kearns [2]. This is a systematic procedure to present the elements of a problem in a hierarchy. Initially, the problem is consistently decomposed into smaller constituent elements. Then, experts are expected to present the intensity of impact between the elements in the hierarchy, based on a series of comparisons between pairs of elements. Pairwise comparisons are made by combining the experts' individual opinions. The process allows documentation and repetition.

Members of the expert group are to express their opinion on the mutual significance of the elements in pairs. Experts use a nine-positional comparison scale. For each pair of compared items "1" means that they are equally significant, while "9" means that one element is in the highest degree more significant than the other. Experts are not necessarily obliged to observe the laws of formal logic in presenting their views. If, for example, they believe that element "A" is more significant than element "B", and element "B" is more significant than element "C", they do not have to indicate that element "A" is more significant than element "C". This clarification is made for experts to focus on their intuitive formulated position, and not on the formal logic laws.

The proposed by Thomas Saaty computational procedure allows for such inconsistencies. At the same time, it is possible to quantify the inconsistency by calculating the consistency index. If the inconsistency does not exceed certain empirically established boundaries, then the results can be considered reliable. Otherwise, experts shall be asked to reconsider their opinions, taking into account results from the first iteration, and repeat the procedure once again.

For the purpose of this study, the following hierarchical structure was developed:

First level – goal – to provide safe living conditions to the population and successful operation of the businesses in the selected region.

Second level – natural disasters that may occur in the selected region.

Third level – indicators used to assess the priority of each natural disaster – probability of occurrence and damage provided that the disaster occurs.

3. Content of the study

This study was conducted in several steps. First, the region to be examined was identified. After research, the author selected Sofia city (see Fig. 1). A large percentage of the population live in the region and possible natural disasters can affect many people. The region

is characterized by urban area, as well as by mountains, woods, rivers and large dams. The area is saturated with infrastructure; many of the sites are categorized as critical infrastructure.

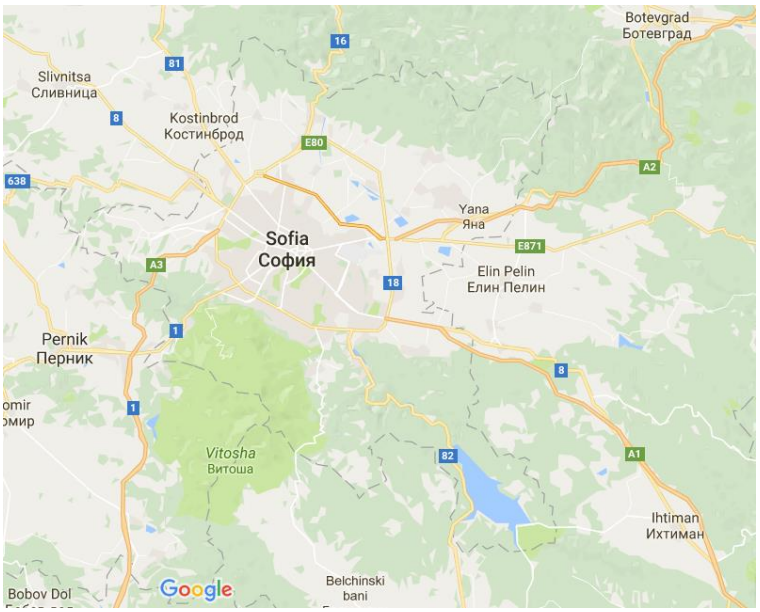

Fig. 1. Geographical map of the region of Sofia-city, Source: google.bg/maps, https://www.google.bg/maps/place/%D0%A1%D0%BE%D1%84%D0%B8%D1%8F-%D0%B3%D1%80%D0%B0%D0%B4/@42.6541634,23.0847828,10z/data=!3m1!4b1!4m5!3m4!1s0x40aa868332a0a5a3:0x300a01269bf4d70!8m2!3d42.7570109!4d23.4504683

Second, possible natural disasters of high priority for the region were identified. Research helped to compile a list with the most frequently discussed and evaluated natural disasters. Then, discussions with experts examining real natural disasters helped to enlarge the list. Next, natural disasters that are not typical for the region and whose probability of occurrence is negligible were excluded from the study – for example, tsunami.

The selection of experts to participate in the study was carried out very carefully. Experts had to meet a series of requirements – to be experts in the field, to be competent on conducting expertise, to have analytical thinking and willingness to participate. Experts from the following institutions were selected:

1. National and Regional Security Department, University of National and World Economy
2. Center for Strategic Studies in Defense and Security, University of National and World Economy.
3. Bulgarian Academy of Sciences, Institute of Metal Science, Equipment and Technologies "Acad. A. Balevski" with Hydroaerodynamics Centre
4. Bulgarian Academy of Sciences. Centre for Research on National Security and Defense
5. Ministry of Defense

The questionnaire was developed on Excel software. Multiple versions were developed and tested. Ultimately, the selected option allows for unambiguous interpretation of the questions and is not highly technically demanding. The calculation module was also developed by Excel software. It enables uploading data from all experts and summarizing information.

The module calculates coefficients necessary for the consistency of individual and summarized assessments. Once all necessary calculations are made, the module presents the results in tabular and graphical form. The development of the module ended with verification of the calculation algorithm.

A letter was sent to all selected experts with the questionnaire, instructions for its completion, and a deadline. Out of 35 invited experts, 21 answered (60%) in due time. Responses were analyzed and consistency ratios were calculated for each expert. Results show that most of the responses had consistency ratios around and below 0.1. According to T. Saaty, such values are acceptable and it can be assumed that the degree of consistency of individual opinions is high enough. The ratios of two experts exceeded 0.2. Their views were excluded from further processing.

Experts' opinions with sufficiently high level of consistency were summarized using Saaty methodology. The result was two vectors – concerning views on the level of probability of occurrence of disasters, and the expected damages in case of occurrence. The results are presented in numerical and graphical form. Fig. 2 and 3 show the range of disasters according to probability and damage.

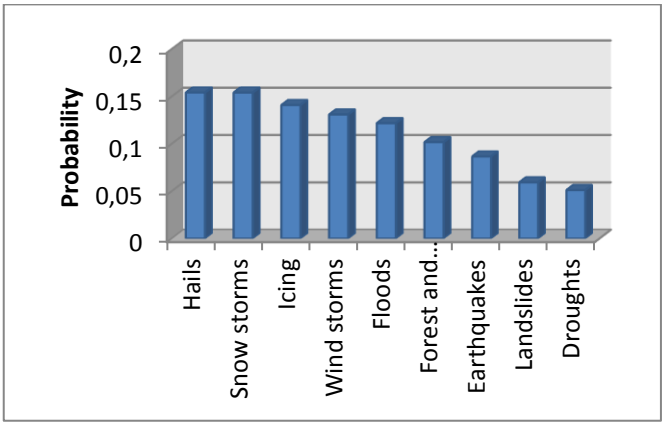

Fig. 2. Disasters in Sofia-city region arranged by probability of occurrence

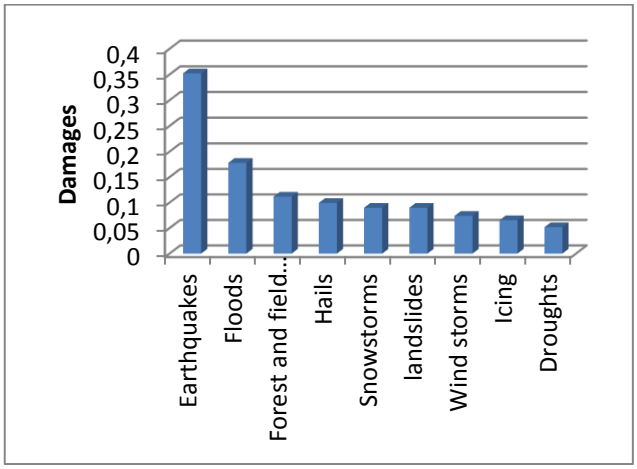

Fig. 3. Disasters in Sofia-city region arranged by expected damage in case of occurrence

Experts assessed hails, snowstorms and icing as the most likely natural disasters (by coefficients 0.15, 0.15 and 0.14) and most unlikely – earthquakes, landslides and droughts (by coefficients 0.09, 0.06 and 0.05). Experts unanimously believe that the greatest potential damage can be caused by earthquakes (coefficient 0.35). Significantly smaller damage is expected from floods (coefficient 0.18) and forest and field fires (coefficient 0.11). Icing and droughts have the lowest potential damage estimate (coefficients 0.06 and 0.05 respectively).

An important methodological aspect is how to assess natural disasters simultaneously by both parameters in order to get summative evaluation and to prioritize them. There are several possibilities that differ in complexity and influence of subjective opinions. One of the most common methods used in risk management is the graphics. After individual risks are assessed by probability of occurrence and expected damage, they are depicted in a coordinate system where the axes show probabilities and damages respectively.

The two axes can be divided into five sections wherein they form 25 fields. In this way, risks can be assessed by priority. The result of such an assessment of natural disasters in the region of Sofia-city is represented in Fig. 4. The priority of any natural disaster can be estimated by experts, taking into account the distance between its corresponding point and the origin. It is obvious that according to experts earthquakes have the highest priority and droughts – the lowest.

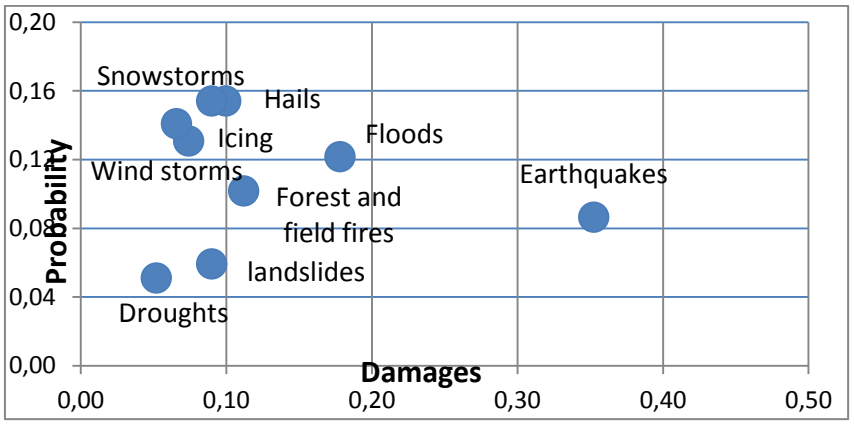

Fig. 4. Positioning of natural disasters according to probability of occurrence and potential damage

It is possible to use another, quantitative approach to calculate accurately the priority of each phenomenon. For this purpose, it is necessary to determine in advance the relative importance of probability and damage estimates for the priority of disaster. Then, the priority of disaster can be calculated as an average of these estimates. Weights are the coefficients of relative importance of probability and damage. If we assume that probability and damage are equally important for the disaster priority, evaluation of priorities can be calculated as the product of the coefficients of the relative importance of probabilities and expected losses for any disaster. Taking into account the expertise of disasters in the region of Sofia-city, results are as follows (Table. 1).

After these calculations have been performed, it is possible to focus efforts on the analysis of the consistency between individual opinions of experts. Analyzing coefficients of concordance of experts' opinions in terms of probability and damage makes possible the arrangement of experts according to the value of this coefficient. This can serve as a reliable

basis for assessing the level of involvement of experts to the task. This information can be considered in the selection of experts for future projects.

Table 1. Assessment of the relative importance of natural disasters in the region of Sofia-city

Natural disaster	Relative importance coefficient
Floods	0.021662
Droughts	0.002642
Forest and field fires	0.011359
Landslides	0.005323
Wind storms	0.00969
Hails	0.015321
Snow storms	0.013854
Icing	0.009236
Earthquakes	0.030479

After arranging the disasters by priority, the result can be presented as follows (Fig. 5).

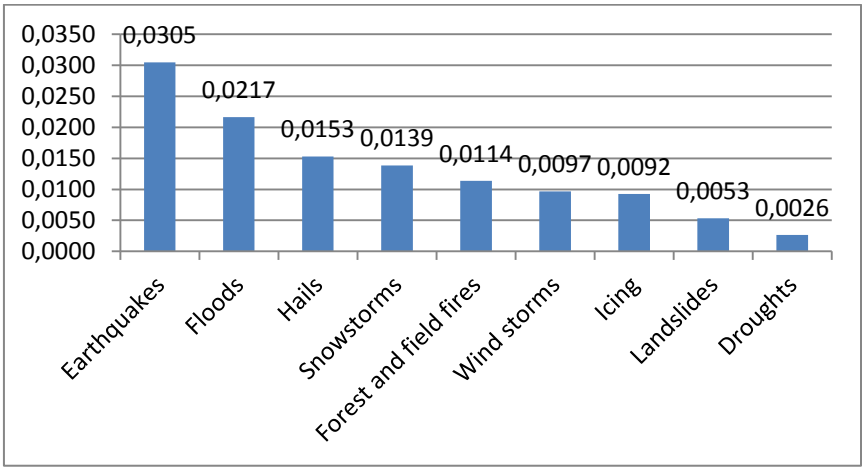

Fig. 4. Arrangement of natural disasters in the region of Sofia-city by priority

The difference between experts' views on the importance of each pair of disasters can be evaluated and interpreted. This can give information on which disaster pairs generate more hesitation than others. Findings from the survey:

The standard deviation between the views of experts comparing the probability of icing and earthquakes is the highest – 3.384. This result can be explained by the high degree of hesitation while comparing the degree of probability of these phenomena. The lowest value belongs to the standard deviation between the views of experts when comparing the probability of floods and droughts – 0.71. This result can be explained by the high degree of confidence when comparing the probabilities of occurrence of these phenomena.

The standard deviation between the views of experts comparing the damage from landslides and earthquakes is the highest – 3.12. The lowest value is the correlation coefficient between the views of experts comparing the damage from snowstorms and snowdrifts and icing – 1.082. These results may lead to the conclusion that further studies are needed through

expertise and other approaches to assess more accurately the relative importance of icing, earthquakes and landslides.

4. Conclusions and Recommendations

As a result of the above, the following conclusions could be drawn:

1. Risks of natural disasters in a region can be assessed by adopting the widely accepted practice for their evaluation on probability of occurrence and estimated damage in case of occurrence. Statistics from natural disasters in the past are not always sufficient. They must be combined with a summary of experts' opinions.

2. A suitable method for summarizing experts' opinions in ranking the risks of natural disasters according to priority is the model of Thomas Saaty Analytic Hierarchy Process. The method may be used not only for quantitative evaluation of priorities, but also in several additional directions.

3. The Excel software provides a convenient platform for AHP model. It can be used not only for the development of questionnaires, but also for the collection of individual opinions, and in summarizing the views and additional calculations.

4. In addition to purely numerical results, Excel allows to present results graphically and thus to interpret them relatively easily.

5. Expert opinion study on the probability of natural disasters in the region of Sofia-city arranged them in the following way (sorted from most likely to least likely): Hails, Snow storms, Icing, Wind storms, Floods, Forest and field fires, Earthquakes, Landslides, Droughts.

6. Expert opinion study on the expected damage in the event of natural disasters in the region of Sofia-city arranged them in the following way (sorted from highest to lowest damage): Earthquakes, Floods, Forest and field fires, Hails, Snowstorms, Landslides, Windstorms, Icing, and Droughts.

7. Expert opinion study on natural disasters priorities in the region of Sofia-city arranged them in the following order (from highest to lowest priority): earthquakes, floods, hails, snowstorms, forest and field fires, wind storms, icing, landslides, droughts. The results of this analysis can help local authorities in Sofia-city in allocating resources and efforts to prevent these disasters.

Acknowledgment

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Predictive Identification Approach for Emerging IoT Hybrid Threats

Zlatogor Minchev[1,2], Luben Boyanov[3]

[1]Institute of ICT, Bulgarian Academy of Sciences, Sofia, Bulgaria
[2] Institute of Mathematics & Informatics, Bulgarian Academy of Sciences, Sofia, Bulgaria
[3] University of National and World Economy, Sofia, Bulgaria
zlatogor@bas.bg, lboyanov@unwe.bg

Abstract. Progressive digital world is evolutionary encompassing new web connected devices and services towards multiple people's activities. In this sense, mobile technologies smart progress and the 'Internet-Of-Things' – 'IoT' phenomenon with fast miniaturization are expected to influence significantly our quality and style of life in the near future. The paper outlines an idea for predictive identification of emerging hybrid threats, concerning new IoT digital environment, as a result of human-machine smart interaction. A threefold approach is accomplished, implementing: (i) probabilistic landscape definition, (ii) analytical system modelling & (iii) experimental results assessment via gaming simulation in mixed reality environment. A possible progress towards better understanding and predicting of IoT emerging hybrid threats is finally discussed.

Keywords. IoT, hybrid IoT threats, human-machine mixed interaction, system modelling.

1. Introduction

The digital changes of modern world are already producing a revolutionary living transformation. People have already learned to cope with computers, Internet and mobile phones and the new world of IoT gadgets is somewhat replacing their environment and habits. This provides a more convenient and comfortable access to information and services and improves the quality of life. The outlined digital and social transformations, due to their scope, impact and mass penetration, are often reckoned as the *Fourth Industrial Revolution* [1]. The main difference, with the previous big industrial changes in human society, is the great dynamics, which could produce not enough prepared society for some of the new changes. Another difference is the fast adaptation of developed countries, including industrial and living levels. By now, for the last 20 years, people have learned to use computers and get connected to each other by Internet and mobile phones. The majority of desktop activities, linked to multimedia, information, data and documents have also changed completely. Today, people using modern smart technologies can easily order any item from e-shops, make payments, play games and even watch movies while being at home or on-the-fly, doing simultaneously other activities. However, very little has been changed in the objective environment – homes, cities, transportation, personal belongings, etc. Emerging technologies – sensors, robots, vehicles, energy conservation and usage, nanotech developments, 3D printing and the global connected digital devices are changing our world. Digital technology is already incorporated in almost everything and at the same time – connected to something or somebody else, which at the end is available to us – the people.

Evidently, the *Fourth Revolution* is changing the behavior, opportunities and threats for

the newly transformed world. Presently, one of the most dangerous threats with unforeseen social effects are the loss of typical jobs in regular services and productions. A statistical assessment on the jobs dynamics, considers 47% of the US jobs to be at risk from the smart new world [2]. There are other risks as well – just like our smartphones do not leave us with much time to pause, reflect and even have a proper in person conversations, the total digitalization and interconnection might produce negative and unpredictable impact to our society and life.

Thus people must try to identify the emerging threats in the new digital world proactively. An outlook in one particular direction – the hybrid threats within the IoT digital environment is further presented in the paper.

2. Probabilistic IoT Hybrid Threats Landscape

Hybrid threat is a complex, multidimensional phenomenon. The term is often used with references to hybrid war (i.e. ethnic conflict, terrorism, migration, and weak institutions), bearing in mind military, diplomatic and technological means, which are usually considered [3]. However, we use the term *hybrid threats* to denote complex challenges, which are related to dimensions like: digital services, human-machine interfacing, human-machine-environment mixed interaction, technological challenges, social issues etc. [5], [6]. In this sense a very recent study [4] generalizing IoT hybrid threats landscape trends is implemented from a probabilistic perspective. Four key web services IoT future applications, concerning: 'Advanced Multimedia Entertainments, 'Improving Quality of E-life', 'Advanced AI', 'Automated Bio Identification' are used. The resulting prognostic expectations towards year 2021 are cross-calculated vs hybrid threats influence (see Figure 1) of another quad tuple: 'Privacy & Social Engineering', 'Data Breaching & Espionage', 'Malware & Targeted Attacks' and 'Compromised-by-Design Equipment'.

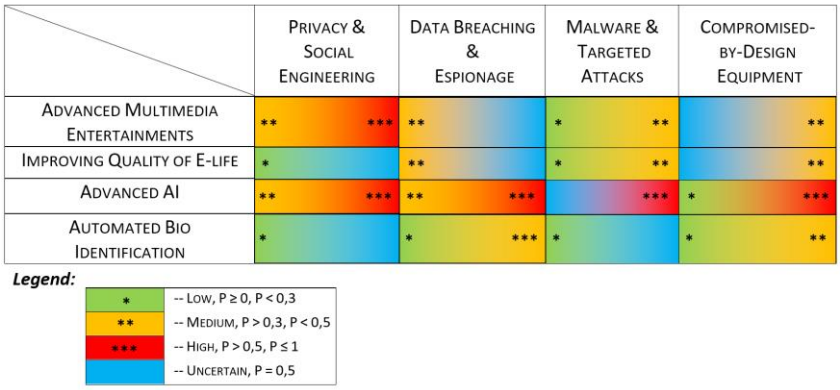

Fig. 1. Aggregated results for future web services, implementing IoT gadgets vs expected complex hybrid threats evolving probabilities up to year 2021.

The obtained results are giving special note to 'Advanced AI' and numerous of uncertainties noted in: 'Advanced Multimedia Entertainments', 'Improving Quality of E-life' and 'Automated Bio Identification'. Some of these findings are also marked and by other respective analyses (see e.g. [7]) but do not explain the origin of the new hybrid threats evolution. Thus next in the paper an analytical system modelling is going to be presented, trying to give some useful answers of this rather comprehensive question.

3. Analytical System Modelling

This stage is organized following the experience from some recent joint industrial achievements for probabilistic expert modelling and risk assessment, concerning cyber space [8].

The process in itself was performed, using I-SCIP-RA software environment. A concept for 'Entity-Relationship' interpretation is assumed in an oriented graph approach with probabilistic arcs weighting. All entities (graphs nodes) are marked with labeled round rectangles, while relations (arcs) are bidirectional arrows, labeled via probabilistic weight values.

A final 3D *System Risk Diagram* (*SR Diagram*) is produced, identifying both 'critical' and 'non-critical' entities (noted with indexed balls, separated from the north-west/south-east risk cube main diagonal). Additional 'active' or 'passive' roles are assumed with white or grey colors for the model entities. These classifications are based on aggregated system risk usage – R_s (z - axis), resulting from: forward – R_f (x - axis) and backward – R_b (y - axis) probabilistic expert values.

The analytical modeling was organized within ten entities from modern digital world (see Figure 2), distributed among the four hybrid threats facets noted in Figure 1 as follows: *Privacy & Social Engineering*: 'Users' & 'Stimulated Responses'; *Data Breaching & Espionage*: 'Cloud Utilities' & 'Third-Party Players'; *Malware & Targeted Attacks*: 'M2M Adv Interactions' & 'Advanced Comms'; *Compromised-by-Design Equipment*: 'IoT Platforms', 'Mixed Reality', 'H-M Smart Interfacing'.

Resulting entities risk classification is obtained for both a priori and a posteriori threats landscape evolution, regarding different digital services future evolution. The presented example is illustrating 'Improving Quality of E-life' services being the most uncertain one (see Figure 1) for year 2021.

The initial assumptions for year 2016 are defining as *critical* four entities from the whole ten: 'passive': 'IoT Platforms' – 1, 'Users' – 4; 'active': 'M2M Adv Interactions' – 2 and 'Mixed Reality' – 7.

The future expectations towards year 2021 in the present example are adding more entities to the critical ones, as follows: 'Third-Party Players' – 6, 'Cloud Utilities' – 3 & 'Stimulated Responses' – 8.

An overall change is also observed and from the perspective of role changes, giving active ones only for the critical entities 'Third-Party Players'- 6&'M2M Adv Interactions'- 2

The presented results though not exhaustive, regarding all four digital services from Figure 1, could be summarized as follows:

New technological digital progress is expected to produce up to year 2021 numerous hidden threats hybridization from 'human-environment-machine' smart interactions, giving leading priorities to the new mixed reality with disruptive cloud services and IoT gadgets. The positive scenarios in this context provide an objective capability for hackers' intrusions control with the active role of third-party players and AI progress. At the same time however these are producing a strong possibility for autonomous machine generated hybrid threats emerging.

4. Experimental Results Assessment

Proper understanding of prognostic results presented so far is a challenging task, especially in the proactive advanced context. A suitable support in this sense could be achieved with human-machine interactive gaming assessment in an artificial polygon environment [9]. Generally, the process in itself is a verification procedure, as the comprehensive outlook towards future cyber threats evolution is resulting a multicriteria assessment of the gaming participants' responses. Regarding the present study, a useful approach was given by CYREX

2016 event [10], concerning IoT concept as a mobile smart gadgets implementation in mixed cyber-physical reality.

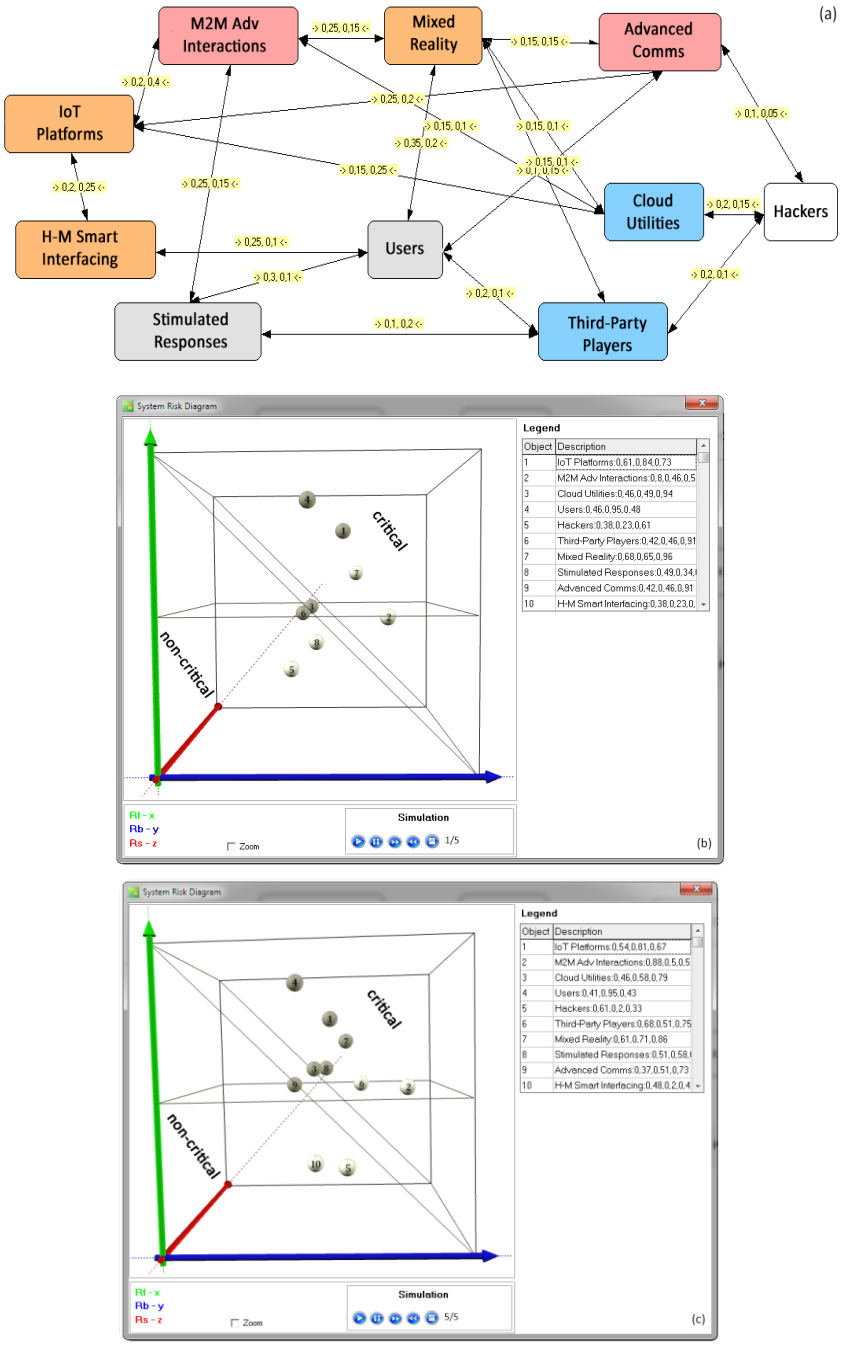

Fig. 2. IoT hybrid threats analytical modelling (a) and resulting a priori – 2016 (b) and a posteriori – 2021 (c) SR assessment diagrams examples in I-SCIP-RA environment.

About thirty participants spread in five teams successfully experimented multiple intrusions originating from social engineering based on hacktivism and industrial espionage. Different techniques were implemented in the exercise [4]: QR codes, multimedia avatars, encrypted hyperlinks, fake identities, DDoS attacks.

Multiple feedbacks (see Figure 3), concerning expected and unexpected exercise scenario scripted events, response times and impressions were gathered using communication router logs and self-reporting digital questionnaires during and after the exercise.

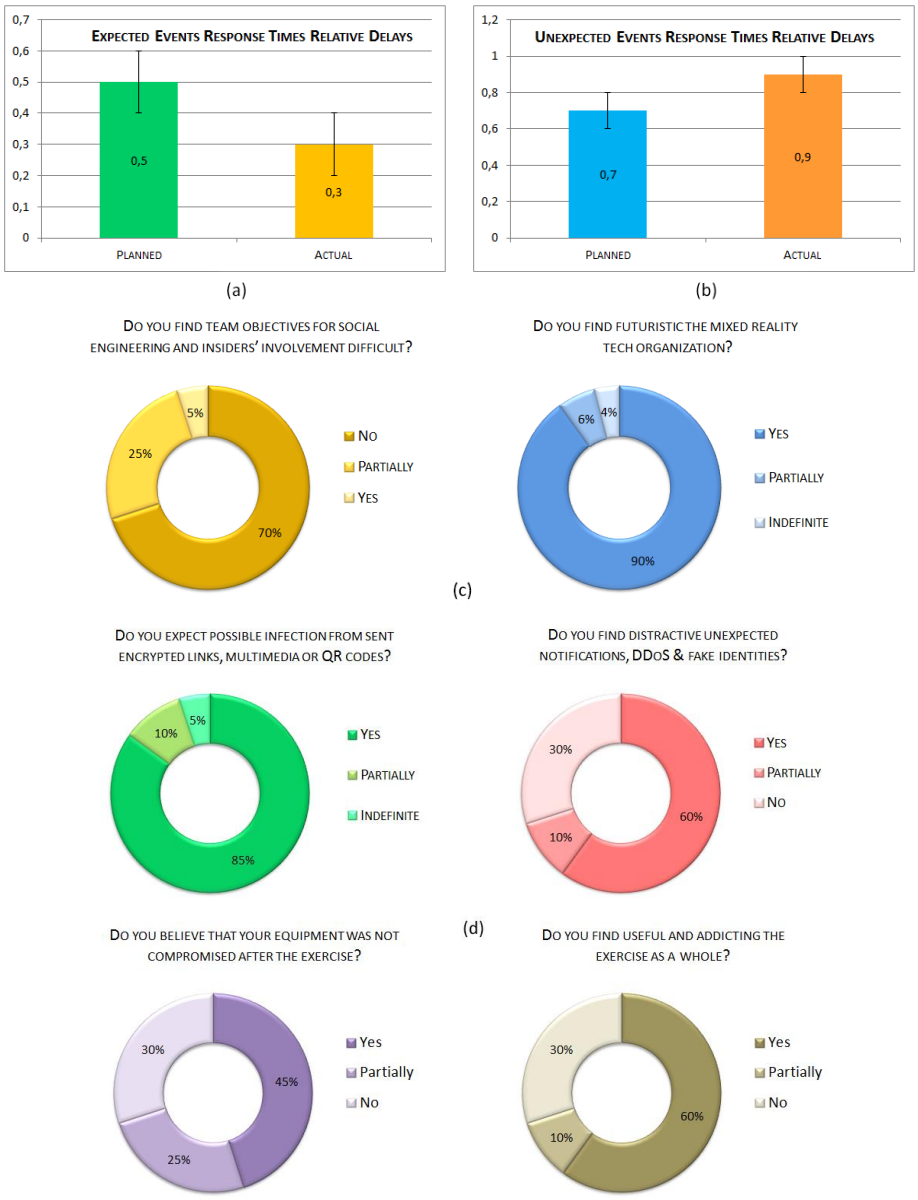

Fig. 3. CYREX 2016 feedbacks aggregated illustration, concerning: relative delays of expected (a), unexpected (b) events, organization (c), tech and overall effect assessments (d).

Three important findings, obtained from CYREX 2016, concerning future hybrid threats better understanding could be noted, extending the ones from [4]:

– IoT gadgets fast evolving connectivity in the near future, based on different cloud platforms is generally offering new, transformed 'human-machine-environment' interaction level;

– Future hypermedia will inevitably encompass IoT smart gadgets in modern cyber-physical mixed reality, producing numerous improvements for the quality of E-life, but at the same time, a lot of behavioral disruptive changes, innovative technological services and uncertainties;

– The social dynamics in the near 2021 digital world will be strongly influenced by third-parity players and machine generated AI, used from both state and non-state actors with resulting multiple unexpected future hybrid threats and attack vectors in the new multiplatform-connected world.

5. Conclusion

The presented methodological approach for proactive identification of future IoT hybrid threats is establishing a solid base for complex exploration of new digital world phenomena. Further on, the probabilistic ideas, together with graph-based representation implemented in the study, are giving an intuitive and convenient modelling environment. Finally, due to the prognostic nature of the accomplished results, the proposed interactive gaming assessment could be extended, regarding the participants' active support with more biometric feedbacks, using wearable/implanted IoT smart gadgets for monitoring in real-time the dynamics of physiological correlates (like: heart rate variability, galvanic skin response & temperature). This will provide a measurable human factor response towards future digital technologies disruptive social transformations and could foresee the new hybrid threats multilateral effects.

Acknowledgement

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Computer – Based Training and Exercises in Project Management

Irena Nikolova

Space Research and Technology Institute - BAS, Sofia, Bulgaria
irena.nikolova@space.bas.bg

Abstract. The paper presents a modern approach for project management education and training and its effectiveness and value added. The benefits of involving advanced digital technologies and simulation in the process of project management and improving the qualification of project managers are outlined. Computer-based training creates a powerful digital environment that changes the current approach to project management education. Its goals are to bring closer theory to practice, knowledge to skills, abstract formulas and definitions to real life. To make learning more effective and practical.

Keywords: Computer-based training, Exercises, Project management, Effectiveness, Education

1. Introduction

Project management is a core component of the overall good governance system, from managing a portfolio of projects, programs, strategic management of organizations.

Globally, the environment in which projects are implemented has become highly dynamic and unpredictable. The projects become more and more complex due to the growing demands of the stakeholders, the variety of different standards, increasing expectations for end results, applications, infrastructure, both transparency and cost-effectiveness. All this increases the risks associated with the implementation of the projects. The focus on project management has been shifted from getting projects completed within scope, time, schedule, and costs to ensuring that projects outcomes satisfy customers and all stakeholders. [1]

Frequent changes in the project environment create difficulties for the project managers to use tradition project management methods. Digital technologies and simulations offer a perspective way for capabilities development in leaders and project managers, their strategic thinking, building their financial knowledge and understanding. The computer-based training and exercises could be considered as laboratories where project managers can observe the impact of their decisions and to practice the skills they use in their daily work.

2. Computer – based training

People in the 21st century work on a daily basis in various projects as part of their job or in their private life and regardless of the profession, its expected to have certain competencies and be able to participate adequately in a project. However, the fact is that there are many challenges that complicate the smooth running of the projects.

In today's ever-changing environment, in order to be competitive, each organization must be flexible and adaptable. Project management is considered as one of the most modern approaches of change management. This approach is a formalized and structured method of managing changes under common rules.

The new conditions require applying of new concepts and technologies in the field of

project management. The high demands for project management require continuous improvement of the manager's ability to make decisions in unforeseen situations, which outweigh the development of planned activities. Managing and leading projects require essential personal skills, learning skills and career skills. Project managers need to be efficient, productive and cost-effective in order to accomplish the projects successfully. For this reason, individuals who wish to become full-fledged project managers need frequent training to ensure they are well prepared for the management role. Knowledge and competency are vital for effective project managing, but training plays a crucial role in establishing self-confidence in project managers. The training helps project manager to understand potential challenges they may face and how to deal with any problems that could arise, and minimizing the effect of the possible obstacles.

Current technologies bridge the training needs and improvement of capabilities. The technologies provide optimal way for resolving key issues on national and global level and are appropriate for enhancing the preparedness and training. Applying the simulation methodologies and tools in the training is a new form for capabilities development.

In the recent years as a very powerful approach for verification of the preparedness of the responsible individuals and authorities in case of project management breaches in the organizations, the Computer Based Training (CBT) and Computer assisted exercises (CAX) are used [2].

Computer-based training is also referred to computer-assisted learning, computer assisted instruction, computer-based instruction and computer-assisted testing. Regardless of the names, computer-based training deliver capacity building with a computer and special software [3]. CBT can be synchronous and asynchronous, as well as online, web-based, mobile, and distance learning. CBT is considered an interactive learning method. This can be done by using certain techniques that can make computer-based training not only interesting, but also effective. CBT can be more successful than traditional forms of learning because it offers more variety of instructional methods. There are different teaching techniques used in CBT. Each method is designed for specific purposes. The techniques may be used alone or combined [4].

Tutorials

This is a common technique used in CBT to help introduce the learner to new concepts and information in a sequential form. With this technique, the information is presented in a lecture format that introduces ideas in a logical manner. Tutorials can be used to teach rules or procedures.

Drill and Practice

CBT can be effective if practice exercises are included in the training. Drill and practice techniques will help you master an idea. This technique is normally used when information is new to you. It is designed to commit information to memory through repetitive practice. This type of technique is comparable to using flashcards to memorize vocabulary terms.

Games

Training games are often used as a funny way to learn. This type of technique is designed to be motivating and entertaining, making learning fun. This technique is like any computer game but with an educational slant to it. Such practice exercises will also help in applying the new skills that are taught as part of the training. When learners play these games, not only do their interest levels peak, but they are also encouraged to practice and discover patterns and relationships in the training material.

Simulation

Simulation help to practice real world situations. Typically, simulations are used when actually practicing in the real world would be too costly, dangerous or otherwise impractical.

Simulations are useful when learners have to practice a newly acquired skill. Through simulations, learners can test and develop their skills and experiment with techniques through trial and error. The interactive environment allows learners to master their skills.

Problem-Solving

Problem-solving techniques, when included in CBT, help to develop critical thinking skills. Also can develop skills in logic and following directions. When these techniques are used in computer-based training, it can be effective to achieve the learning targets in a better way.

Demo and Presentation

Demonstration and presentation techniques are often used to assist with reviewing information that has been learned. This type of technique works a lot like traditional learning environments where the training audience is presented information by an instructor in a lecture-style format [5].

Digital technologies create conditions for technology and intelligence to work together, and the capacity of this synergetic system could be much higher than the capacity of the individual mind. Quick access to unlimited sources of information is widely used thanks to modern technology [6].

In the "Learning Pyramid" (fig.1) by the well-known American expert Edgar Dale, the rate of memory of information is dependent on the way we learn. It shows that the more actively we are engaged in the learning process, the better we learn.

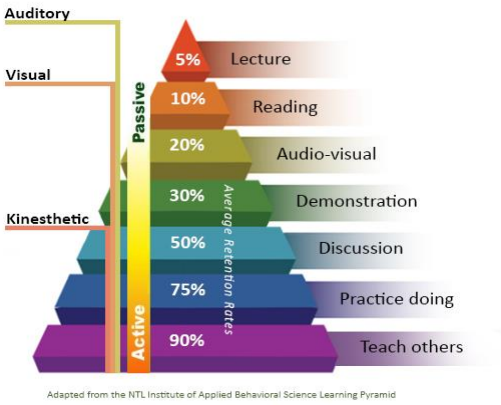

Fig.1. Learning pyramid [7]

According to Edgar Dale's Cone of Experience, 80% of the matter memorized if learning is a simulation of real experience. Learners will remember only 20% of what they learn, but the theoretical learning imparted through CBT will be better retained if the training is accompanied with practical exercises at the end of the lesson.

It is far less effective and expensive if the project management competencies are taught on real projects, while computer-based training and simulations are one of the most effective and safe ways for capacity building for a team to exercise new skills, changes in organization and processes.

3. Computer assisted exercises

Project managers have a crucial role that requires negotiations with numerous parties while monitoring complex data and managing project progress. Usually, the decisions taken

are based on 30% data, 30% group thinking and 40% intuition and past experience. Simulation is useful for project decision-making because it gives a detailed look at the project implementation and progress and provides complete set of relationships, interactions, and uncertainties.

The Computer Assisted Exercise is an effective tool for individual and collective training for the achievement of a certain level of knowledge and capability development for an effective project management skills. The CAX reduces the risk level, enables "time jumps" and scenario repetitions for a short time interval, as well enables scenario simulation which practical implementation is very difficult to achieve with unexpected negative consequences [8]. Simulation creates a realistic, simulated environment that allows trainees to explore complex situations or best practices, while creating deeper understanding of available choices, analyzing potential risks and/or benefits, and learning from simulated results versus (un)intended consequences. Simulation-based learning has been recognized to be very effective, long-term method for learning any acquiring new skills.

Computer-assisted exercises are cost-efficient and highly effective tools for project management capacity building. They could be indispensable part of the regular project management training and operation exercises.

In its nature CAX is a "synthetic" training, where the people and resources are generated, operated and managed in a simulation environment [9]. CAX is a dynamic and interactive training, and enables participants to test new strategies and plans in rapidly changing situations. CAX is more effective than conventional teaching methods in providing insight into abstract concepts of the project management.

CAX for project management contributes significantly for enhancing the expertise of project managers, decision-makers and high-level management. During the CAX, experience is real, invoking real emotions and real learning. Challenges are presented to manage a project to get the work done on time and in budget. While running the CAX the project manager's decisions have consequences and impact the bottom line results of the project (time, cost, and quality). There is no "right" answer, there are many paths to success and just like on real projects, there is lots of uncertainty (random events).

Taking part in CAX, participants are more emotionally involved and interested to learn more. This training provides the opportunity for discussions from which valuable opinions can be collected and considered. After a CAX day in a room to solve problems, play different scenarios, test various strategies, plans and to achieve common results, the team gets more cohesive, more professional and definitely with improved communication skills.

Project management CAX promotes close team collaboration and communication. Communication, planning and proper interaction between stakeholders is one of the most important points in the project. Planning and the coordination between all stakeholders and project actors are the most challenging activities.

Computer assisted exercises drives four main processes:

- VALIDATION – validation of project management strategies, plans, procedures and demonstration of resolved issues;
- PREPARATION - developing the competence of the project team through practical skills training on the given task in the respective plan, as well as assessing their improvement and development;
- TESTING - testing of procedures already in place and possible gaps that may arise;
- In recent years, a fourth feature has become a key one: EXPERIMENTATION - it is a process with only positive results.

4. Benefits

CBT benefits:

- Interactive and engaging

One of the great benefits of the computer-based training is that participants can make decisions and see and more importantly, understand) the consequences of their decisions. The casual and fun environment makes the team more open and more inclined to acknowledge the wrong decisions and join together to correct them for successfully completing the project. This is an approach that enables skills practicing in a real business environment.

- Immediate feedback

One of the best moments in computer-based training is getting instant feedback. All participants leave the session knowing how they have managed individually, as a team or as an organization. Through project simulation, in just one day, the critical areas of team effectiveness stand out and identify, and one problem only be solved if it is realized.

- CBT gives trainers increased control over training activities;
- Available 24/7 and just in time. Enables individuals to find and use the information needed exactly when they need it most.

The benefits of using simulations: [10]

- The simulation teaches technical and soft skills in an integrated way;
- Increased efficiency of employees in the project management department;
- Improved internal project management process;
- Company save time and money by training project managers across the globe simultaneously;
- More effective than conventional teaching methods in providing insight into abstract concepts, related to the project management.

Project simulation, as well as a real project, contains a lot of information to be collected, considered and analyzed. The advantage is that it is introduced interactively and gradually and this allows participants to understand the results and apply it immediately. The few lessons learned sessions enable the trainees to have a look at the whole picture, to realize the mistakes and redefine the processes of interaction between the teams in the project [11].

CAX benefits:

- Learn from own mistakes with reduced risk;
- Quick interaction between cause and effect;
- Build and test project mental models;
- Build and test leadership mental models;
- Try new techniques/approaches;
- Push your performance boundaries;
- Learn by doing;
- Learn from others in a team setting;
- Cost effective;
- Time efficient – "time jumps".

5. How the learning and training assisted by computers can be useful in project management?

- By testing and validating the project plans;
- Preliminary analysis of the organizational structure of the project, roles and

responsibilities in the team;
- Improve coordination and communication;
- Identification of resource gaps and team preparation, as well as activities to improve processes;
- Improving individual and collective performance through practical experience.

CBT, CAX and simulation games have a number of advantages, the most important of which are:
- Shortening the time for preparation and decision-making;
- Reducing the amount of processed documents and allowing more rational time usage;
- Possibility for effective self-training of the players, especially at the stage of preparation of the game;
- Expanding the possibility of playing various issues related to the actions of the decision makers at the different stages of the project management;
- Learning by doing;
- Flexibility;
- Reduction of financial, physical and time expenditures;
- CAX and simulation provide a safe environment for learners to confront typical project problems, select a solution, make mistakes and analyze results.

6. Conclusion

The project management CBT, CAX, simulation, serious gaming is a fascinating way to learn and improve project management skills. Active learning and application helps to memorize most of the practices with enthusiasm. When participants make realistic management decisions in project management simulation and immediately see the results of their actions, important project management principles become part of their natural thinking. In a period of a few hours or days trainees are able to simulate real project management practice, to experiment different strategies and scenarios, or demonstrate different project management model, that can last months or years in the real life.

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Internet of Things in the Economics – the Future

Valentina Terzieva, Katia Todorova, Petia Kademova-Katzarova

IICT – BAS, Sofia, Bulgaria
valia@isdip.bas.bg, katia@isdip.bas.bg, petia@isdip.bas.bg

Abstract. This research focuses on the value that Internet of Things (IoT) can add to different sectors of economy and on the powerful impact they have on industry, affecting productivity and strategic decisions. High performance smart electronic devices form a new digital globality because of their low price and growing use of Internet. Their communicativeness and interactivity accomplishes connectivity of the physical and virtual worlds. They allow for more efficient management and control of processes and thus make the economy competitive. Highly scalable Web services for processing, management and operation of data are already available, which leads to digitized economy.

Keywords. Internet of Things, Economics, Applications.

1. Introduction

The booming development of the Information and Communication Technologies (ICT) as well as the wide spreading Internet leads to a fully connected society and to expansion of the Internet of Things (IoT) in all areas of human activity – from resource extraction, agriculture, manufacturing etc. to more sophisticated like health, education and science i.e. in all sectors of the economy – primary, secondary, tertiary (and quaternary according to some authors). Increasingly common in our daily lives cars run without drivers, appliances inform for running low on products, remote monitoring devices alert doctors of blood pressure's or heart rhythm's dangerous values, thermostats adjust energy settings depending on whether there are people in buildings, sensors report for traffic jams and available parking places, etc. This widespread adoption of smart devices improves daily lives of people as well as the connection between them and their electronic devices.

This reality encourages an evolution from communication between computers to communication between devices. Numerous physical things around us become part of global digital economy as they can be easily searched, identified and controlled. The process of digitalization is quite natural and already well established in some sectors, while in others such as resource extraction, agriculture, manufacturing etc. it is still under development. On a global scale, contemporary technological process is becoming "smart", which is changing the economy considerably. The smart industry takes advantage of IoT both to control the workflow environment and impact directly the technology, organization and manufacture. Smart devices create enormous quantities of data that enable stakeholders to make real-time predictive analytics through big data services. Thus, a complete picture of the industrial processes can be obtained, which allows maximizing business efficiency as well as implementing new business models and control strategies.

In this paper, we aim to review how IoT are being adopted by multiple industries. We put emphasis on the impact of IoT on the economy, i.e. improving the efficiency (by applying innovations in production and cost cutting) and also enhancing the competitiveness of

companies (by adopting new technologies either through joint products or providing better quality or even lifetime warranty).

2. The Internet of Things

Historically, the usage of ICT in many areas has been initiated decades ago, while IoT have recently become natural part of our everyday life. Numerous diverse smart objects are located in buildings, vehicles, machines, appliances, environment etc. RFID tags, sensors, actuators, mobile phones, etc. provide advanced services anytime and anyplace through wired or wireless connectivity. Different technologies allow physical items to be controlled remotely, so to perform actions and provide services.

Various IoT are connected in networks, send data to the Internet and cloud via standard protocols (TCP/IP) and communicate to each other through different wireless technologies – ZigBee, WiFi, and Bluetooth. Data transfer can be in three modes: thing-to-thing, thing-to-human and vice versa. Each smart thing has a unique address and can be tracked and physically localized in real time. IoT are energy-optimized and self-organized so that to function autonomously. Devices such as tags, sensors, embedded microchips, etc. reflect changes in parameters of the physical world (temperature, pressure, altitude, motion, location, biometrics, sound, images, etc.), transmit data to each other and command actuators to carry out predefined tasks [1].

Despite their differences and specifics all smart devices have a number of common features such as connectivity, interoperability, localization and traceability, unique addressability, autonomy, scalability, security, energy efficiency, robustness [2]. It is important IoT to be resistant to influences, consistent with the operational conditions, protected from misusing and safe for users. Interoperability is achieved by standardized data formats and meta-data descriptions, which together with wired or wireless connectivity provide the communication between different applications. Another essential issue is scalability of IoT architecture – to be easily expanded or reduced according to users' needs. Autonomy in turn handles the rapid growth of smart devices.

According to their purpose smart things have various implementations. From one point of view they have to be consistent with the place of use – open or closed spaces. The first case is relevant to weather conditions – rain, wind, sunlight, etc. whereas the second concerns the microclimate – room temperature, ventilation, humidity, etc. Sensors for indoor and outdoor usage have different operational characteristics, although they measure values of parameters of the same type (e.g. temperature). From another point of view, they have to serve purposes that are intended for. The most trivial use of IoT is related to managing specific parameters in order to achieve an appropriate microenvironment corresponding to functional purpose and kind of building (school, production hall, office, home etc). Providing suitable microclimate is essential condition – it improves comfort and therefore increases the efficiency of human activity.

Smart applications use heterogeneous IoT devices that enable a myriad of use cases in nearly every environment. Those that are doing the essential work of monitoring processes, taking measurements and collecting data are the sensors – they can fit almost anywhere to monitor almost anything, for example [3, 4]:

- position – in transport and logistics for real time localizing and alerting for traffic jams; in farming for tracking the movement of livestock;
- presence – for checking availability of parking spaces in public places; in agriculture for storage monitoring in silos, dairies, stables etc;

- proximity – in retail trade for sending a product details and deals to customer's smart phone when nearby;
- motion – for vehicle tracking; livestock behaviour monitoring; self-driving vehicles to be controlled remotely;
- velocity – in transport to control the speed limit; in autonomous vehicles;
- temperature – in every environment for continuous measurement of temperature; in manufacturing to control machine operating temperature; in farming for tracking the temperature of soil, water and air;
- humidity – in controlling the humidity of rooms or buildings (silos, warehouses, greenhouses); in specific manufacture processes; in agriculture to regulate the humidity requirements of plants and crops;
- moisture – in agriculture for monitoring plant and soil conditions as well as for controlling water usage for optimal plant growth;
- chemical – in agriculture for determining the need of fertilization based on soil chemistry nutrients; for measuring chemical characteristics of water relative to the requirements of drinking; for determining the acidity of water and soil;
- vibration – in manufacturing for measuring the vibration motions of engines, electric motors, or any mechanical device in operation to track hazards, prevent accidents and bring better safety;
- gas – in controlling the air quality in buildings; in mining to detect fire and dust build-up that can be explosive;
- flow – in monitoring the rivers to prevent flooding; in medicine for monitoring the blood flow;
- pressure – in determining the flow of liquids or gas through pipes to prevent accidents; in vehicles and aircrafts to determine force and altitude;
- leak – in visualizing heat leaks in buildings; in identifying chemicals in the environment;
- level – in detecting the level of liquids, fluids and other granular materials in tanks; in waste recycling; in controlling the irrigation;
- electric – in managing energy usage in buildings to reduce power consumption;
- ambient light – in personalizing the level, kind and quantity of light for individual work spaces in buildings.

There exist massive quantities of other measurements that can be taken by sensors. Among them are displacement, acoustic, sound, force, load, strain, torque, magnetic, acceleration, tilt, optical, etc.

3. IoT in Economic Sectors

According to many experts the widespread adoption of smart appliances is the next industrial revolution – the future way of interaction between businesses, governments, consumers and the physical world. Advanced IoT enable a wide range of new applications in each sector of economy from resource extraction, energy and transport to farming, education and healthcare. They help management of economy and everyday human activities.

The different branches of industry are subjected to different influences due to different origin (natural phenomena, climatic features, anthropogenic and social factors). The latter are of special nature and can not be measured by measurement devices. Their arising and development trend have to be electronically gathered by information systems for collecting and processing of structured, semi-structured and unstructured data, using resources such as electronic mass media and social networks. Obtaining relevant information on social processes

is of a very different type than the collection, analysis and use of technical data. That is why they are not considered further in this paper.

The influence factors can have stronger or weaker effects on the different economic sectors. Especially strong is the influence of the natural factors on the development of economic activities such as agriculture, forestry and logging, hunting and fishing, salt production, and extractive industries – mining (primary sector). Climatic factors (air, its chemical composition, temperature, humidity, atmospheric pressure, wind, sunshine, etc) have a significant impact on the development of agriculture and tourism. Further, influence with direct or indirect impact can be distinguished. Temperature, wind and atmospheric precipitation, for example, are of utmost importance for agriculture, but insignificant for deep mining (primary sector). Weather has a great impact on construction and energy (secondary sector) and also on transport and tourism (tertiary sector). In contrast, the influence on metallurgy (secondary sector) and education (tertiary sector) is limited and indirect (Table 1).

Studying the effects that natural phenomena, climatic features and anthropogenic factors exert on certain economic branches, as well as the interconnections and interactions of the latter, important parameters which have significant influence can be distinguished. The values of these parameters need to be monitored – obtained data are collected and processed in-depth so as to extract useful information: changes, trends, relationships and status of various processes. Subsequently on that basis targeted tests and researches can be carried out and mathematical models can be drawn up in order to forecast future development and events, to identify potential dangers or favourable effects in perspective, to support decision making.

At very low temperatures blocking of waterways can be expected, for example. This means to transfer the traffic to ground and possibly to air. In turn, they can be influenced by quantities of snowfall and by strength and direction of air currents. Information about these processes can be obtained from IoT sensors (e. g. for air and water temperature, water flow velocity, wind direction and speed, air humidity etc). Further this information is used for timely and appropriate reactions of various authorities to restructure certain activities in the affected region: support of roads and rails, change and/or transfer of various supply, emergency and administrative activities in other points (e.g. service of ports, airports, railway stations; supply of essential products and medicines; ensuring access to emergency units) etc.

Low temperatures can affect also the energy system and require involving additional capacities. If HPP activation is needed, monitoring and control of water level, turbidity and other significant parameters of the used water body is required. All these data can be obtained through IoT sensors. Their further processing allows predicting trends and optimizing exploitation: on the one hand water supply and irrigation (and possibly fish farming) have to be secured and on the other hand future atmospheric precipitations – both snow (and snowmelt forecast) and rain have to be taken into account. A long-term forecast for the trend of the atmospheric processes is needed, which can not be attained without IoT and modern data processing such as Big Data and cloud computing.

The impact of influence factors on various economic branches has different delay. The effects can occur immediately or in several months. In the latter case, they can even be bypassed if there is enough time for reaction. This consideration shows that timely interventions allow avoiding many negative consequences and the development of multivariable mathematical prognostic models using the information obtained by IoT plays an extraordinarily role. In this way, preventive and proactive actions can be initiated to counteract the negative consequences.

Table 1 Examples for factors influencing certain economic sectors and branches

direct D (weak)	indirect I (medium)	uninfluential U (strong)

Influence Factors		Natural phenomena	Climatic	Anthropogenic
		Earthquake, volcanic eruption, meteorite falling, landslide	Wind (also hurricane, tornado, sand-spout); atmospheric precipitations, tsunami; temperature (air, ground, water)	contamination of air, soil and land of different origins: industry, artificial fertilization, waste, deforestation, relief-changes, artificial water bodies, ground removal, soil degradation
Sector	Branch			
Primary sector	Agriculture	D	D	D
	Deep / surface mining	D	U D	U
	Forestry	D	D	D
	Fishing & Hunting	D	D	D
	Salt Production	D	D	I
Secondary sector – Heavy industry	Metallurgical	I	U	U
	Mechanical engineering	I	U	U
	Chemical	I	U	U
	Energy	I	D	U
	Logging	I	D	I
Secondary sector – Light industry	Furniture	I	I	I
	Clothes & Shoes	I	I	I
	Food	I	I	I
	Home appliances & electronics	I	U	U
Secondary sector	Construction industry	D	D	U
Tertiary sector	Transport/Telecommunication	D	D	U
	Finance & Commerce	I	I	I
	Healthcare	D	D	D
	Education & Culture	I	I	U
	Mass media	I	I	U
	Government	D	I	I
	Tourism	D	D	I
	Entertainment	I	I	U
	Information technology	I	I	U

4. IoT In Practice

Using IoT in agriculture farmers can get a complete picture of what's happening in their fields and livestock. Collected data via sensors are analyzed in order to assess their current status and to evaluate the need of interventions or changes. In that manner farmers are able to use that knowledge in making evidence-based decisions. Sensors attached to animals track movements, detect position and determine behaviour of free-range livestock. Farmers can be alert for health and wellbeing of animals to prevent the herd from a disease as well as to establish grazing patterns, to obtain stats on feeding and to increase productivity of the livestock. Sensors located in fields, orchards, vineyards and greenhouses enable real-time tracking of environmental parameters such as physical, mineral and chemical composition of the soil, temperature, moisture, humidity, air quality, etc. These data are important for nutrient management as well as for helping farmers in making much more informed agronomic decisions for optimal planting, fertilizing, watering and harvesting in order to increase the overall yield of the crops. From another point of view, the optimization of processes in agriculture helps to control the use of resources and pesticides and in that way, brings to rising environmental responsibility.

IoT makes farms to become smart and connected, so that farmers can remotely monitor their equipment, crops, and livestock. The IoT platforms provide various sensors and smart devices that enable measurement and monitoring numerous parameters, detailed resourcing and mapping, data storage in the cloud, etc. Thus, by gathering information from a wireless sensor network located across farms, the agriculture experts are able to get alerts about dangerous weather conditions (temperature, humidity, precipitation) or other inappropriate factors (high acidity of soil or some imminent problem). They are able to determine the disease risk, to assess in real-time the damage to agricultural crop due to hailstorm, to create statistical forecast for farm productivity, to make different analyses, etc. Moreover, this information and additional services are accessible anywhere, anytime and can lead to a great return on investment for farmers [5, 6, 7, 8].

An example of IoT application in agriculture is Waspmote platform which enables tracking of environmental parameters to increase crop quality and to control the use of pesticides. It has already been applied in many countries in Europe, Asia and Australia for a variety of crops. [9].

Another example is open source IoT platform Kaa, which provides different sensors, connected devices, and farming facilities that allow farmers to develop smart farming solution. It offers smart metering devices, livestock trackers, failure prediction systems, resource mapping and farming produce analytics. The smart farming application gathers raw data and delivers meaningful information about soil and crop status, machinery in use, storage conditions, animal behaviour, energy consumption level, etc. Furthermore, it is scalable and allows modifications and integrations; creates various forecasts based on climate monitoring and statistics on livestock produce and predicts yield [10].

Many of the big ICT companies also develop multipurpose IoT platforms to benefit the almost all sectors of industry. Some examples are as follows: the IoT platform Predix – intended for industrial deployments and provides high-fidelity device simulation [11]; IoT solution Azure – targeted for asset management, remote monitoring, and preventive maintenance [12]; ThingWorx platform – serves both short-range and wireless connectivity and provides multiple solutions for management of various processes in dealing with assets, alerts, product relationships, and workflows [7]; Cisco IoT System – a comprehensive set of technological products for improving productivity and efficiency in many industry sectors from mining, oil and gas, to manufacturing, transportation and utilities, which is based on a system approach to management so it allows quick integration with customer's IT solutions

and can contribute to getting new business insights from different analytics [13].

Some common applications of IoT are for remote monitoring and control of devices and processes, transmitting important alerts to users for prevention of unwanted or dangerous situations. Another usage of IoT sensors is built-in appliances that let retail shops know when they are running low on some goods or allow for location-aware promotions based on customer profiles and proximity. Smart climate control devices allow adjusting energy settings to the times when rooms actually are in use, thereby saving money while also protecting natural resources. In manufacturing IoT enable automation and more streamlined production processes [14].

In the education area IoT devices contribute to monitor and record student's activities and achievements and thus to optimize teaching-learning process. At the same time, personal profile for every student is created, starting at the kindergarten and continuing in the university [1, 15].

Similarly, in the healthcare area it is important personal health profiles to be created and stored. These records typically contain personal and health information, family history; anamnesis, symptoms, allergies, medication and so on. The advantages of making this information available are as follows: ease patient-doctor communication and assist prevention, better monitoring of chronic illnesses, etc., and as a result improve the individuals' health status. Thus, the quality of health care can be enhanced and patients' responsibility and awareness can be increased. Recently launched wireless wearable monitoring devices provide many useful features and can be used both in hospital and at home. Based on these measurements chronic diseases and a wide range of problems can be detected. The obtained data are sent to personal health profiles and doctors are alarmed if necessary. In hospitals IoT sensors optimize usage of advanced medical equipment and thus saving human lives.

5. Conclusion

In recent years IoT are being adopted by multiple industries and they are gaining rising popularity in the agriculture due to the numerous benefits and their applicability. They support and encourage innovations by enabling future "connected enterprises", "connected farms", "connected homes", "connected cities", etc. Smart devices combined with predictive analytics and forecasts allow industry and agriculture to optimize and improve the production processes. Some of the most important transformations are in management and control of working processes, which allow employing the power of innovative technology:

- greater control over production that lead to reduced costs and raising revenues;
- fast development of products and services – active detection of problems during production process, enhanced durability of products;
- reduction in defective products, waste, loss and expenditure, making substantial savings;
- faster innovations and expanding of production line – enhanced competitiveness;
- facilitated services in manufacturing by real-time monitoring of engines – easily failure identification, reduced unexpected maintenance;
- improved effectiveness through analyses of production processes and supply chain;
- enhanced automation and optimized timing of production process – reduced downtime for engines.

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Software Solutions for Managing Processes in Contracting Students for Practical Training

Rosen Kirilov

University of National and World Economy, Sofia, Bulgaria
rosenkirilov@mail.bg

Abstract. This study is devoted to the problems of contracting students, involved in the project BG05M20P001-2.002 "Students practices – Phase I". The processes of computerization of different archives are common solutions and there is ready software for this kind of activities. A careful analysis of the characteristics and peculiarities of this project shows, that it is required the development and implementation of special software solution for automation of operations. The paper presents the characteristics of such an application and its functionality. The paper showcases sample screens from the system and part of the programming code. Finally, the author makes conclusions and recommendations.

Keywords. Software solution, Project management, Practical training

1. Signing contracts with students for practical training

Contracting with students for practical training is shown in the example of activities in the project BG05M20P001-2.002 "Students practices – Phase I" OP "Science and education for smart growth" 2014-2020. A similar project is suitable for the present study, because it offers almost entirely electronic application process, monitoring, management, cost accounting and verifying them. Thus realize the potential for developing support university systems and integration with other software applications and platforms. The project is implemented by the Ministry of Education and Science in partnership with all universities in Bulgaria and is co-financed by the European Social Fund. Much of the project activities are carried out in a specially designed web-based platform [1]. The demand for full implementation of software tools concerning the award of contracts should be implemented based on an analysis of the current legislated procedure execution and reporting of project costs "Student practices – Phase I". In practice, such activities should be developed as a web-based electronic services. In her study, Kirilova describes several key moments in the development of such electronic services, that are possible to implement the ideas in this project [2]. Since the indicative budgets of project partners assume such costs, it has been selected to develop a desktop application to service the processes. The features of the subject area should be reflected in the design and implementation of application software, namely:

- Existing discrepancy between the studied field / specialty of the student and the stated position of the practice and its program. It should be taken into account two features, namely the existence of discrepancies between the register of students supported by the Ministry and the students' system in the University of National and World Economy, due to the large time period for submission of synchronized data from between the University and the Ministry (twice a year); expertly managed procedure for self-registration of the students in the system of Students practices – Phase I;
- Need of management system of academic mentors in terms of number and

specialization in professional fields and specialties. If the system of academic mentors is too wide, it ceteris paribus creates prerequisites for accelerating the processes of contracting that process should be monitored in terms of financial management. Too strait network of academic mentors creates real risks slowing the process of contracting and failure indicators of the project;

- Need of the computerization process of financial risk management of this and similar projects by creating and using an appropriate software tool. These three key risk areas that need to implement in developing a software application related to three stages in the lifecycle of project descriptions, namely: contracting phase, implementation phase and the phase of verification costs.

2. Software solutions for contracting students for practical training

The implementation of the task of software for management of the processes for contracting students is related to the design and programming of individual computer information system. In developing the application, we should use traditional methodology, based on the life cycle in a creation of a system with the following milestones:

- Survey of IT problems on contracting students for practical training;
- Business analysis;
- Design of a software application with a choice of appropriate architecture (desktop application);
- Programming the application;
- Testing and use.

As a result of the project it is a complete desktop software application with the appropriate interface. Fig. 1 shows a sample screen of the process of the contract acceptation of students for practical training. Besides acceptance of contracts the system supports the processes in obtaining contracts signed - Fig. 2.

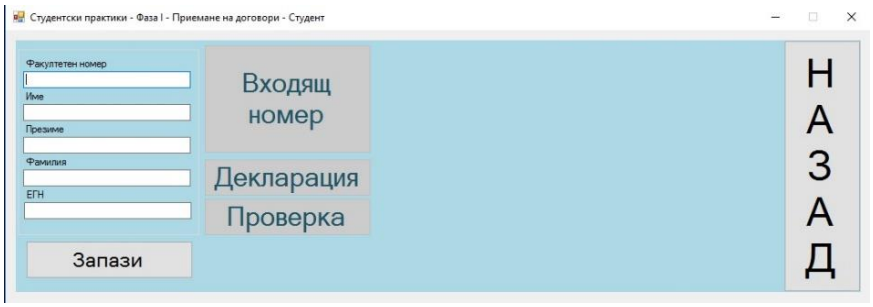

Fig. 1 Sample screen of acceptance of student contracts

Fig. 2 Screen of the developed system

The software application implements the relationship between several business processes of the project. The main are: contracting with students and selection and appointment of academic mentors. To allow coverage of these activities it is made a corresponding interface system (Fig. 3).

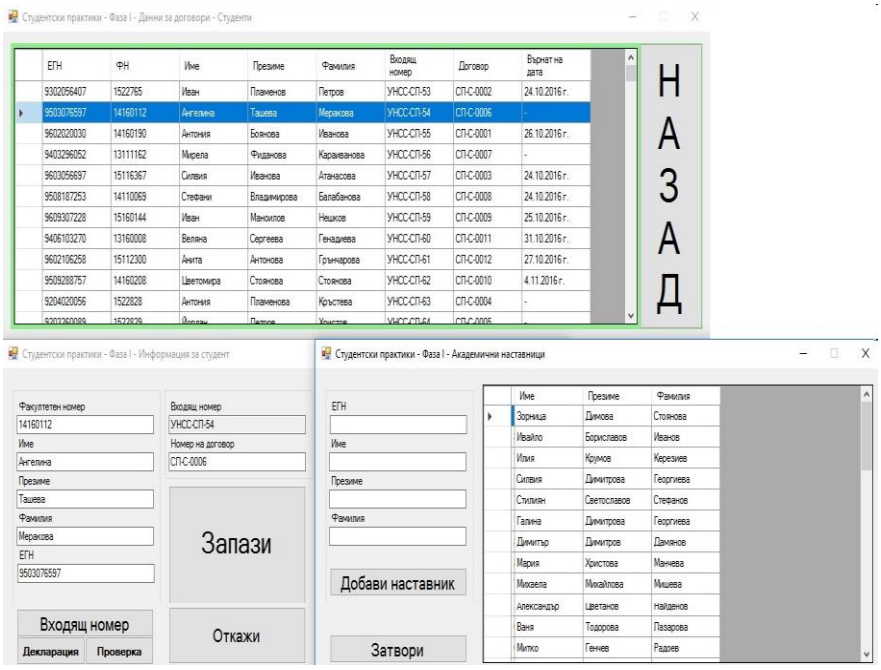

Fig. 3 Relationship between student's contract and contract of selected academic mentor

Program realization of such a solution is complicated and long process. In this process all predefined requirements are translated into program implementation. There are lots of dynamic data to be stored. Technological issues of storing dynamic data in a relational database is described by Milev in one of his studies and it is applicable in the current study [3]. Fig. 4 represents fragments of the source code of the system.

```
LiteDatabase db = new LiteDatabase(LITEDB);

        using (db)
        {
            LiteCollection<PreceptorStudents> preceptorstudents =
db.GetCollection<PreceptorStudents>(PRECEPTOR_STUDENTS);

            List<PreceptorStudents> list_ps = preceptorstudents.FindAll().ToList();

            for (int i = 0; i < list_ps.Count; i++)
            {
                PreceptorStudents ps = list_ps[i];

                string[] ps_students = ps.IdNumberStudents;
```

```
            for (int k = 0; k < ps_students.Length; k++)
            {
               string idNumberStudent = ps_students[k];

               if (this.textBoxFN.Equals(idNumberStudent))
               {
                  for (int j = 0; j < this.comboBoxNastavnik.Items.Count; j++)
                  {
                     Preceptor p = this.comboBoxNastavnik.Items[j] as Preceptor;

                     if (ps.IdNumberPreceptor.Equals(p.IdNumber))
                     {
                        this.comboBoxNastavnik.SelectedIndex = j;

                        return;
                     }
                  }
               }
            }
         }
      }
```

Fig. 4 Source code of a relationship between students and academic mentors

As a result of the research, it is designed and developed a software system to service the specific activity contracting for students on the project. As a result of this realization we can draw conclusions and recommendations for further improvement.

3. Conclusion

As a result of the research we can draw the following conclusions:

- We have analyzed the processes of signing contracts with students to conduct practical training in accordance with the requirements of the project BG05M20P001-2.002 "Students practices – Phase I";
- It is designed a desktop application for service of process by signing contracts with students;
- Using software application will outline the need to create a web-based version.
- Information needs of the team project management and end users will determine the options reference system;
- The application can be developed and integrated with other applications in different processes of the project.

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Issues of Integration of Software Platforms in Field of Higher Education

Rosen Kirilov

University of National and World Economy, Sofia, Bulgaria
rosenkirilov@mail.bg

Abstract. This study is devoted to the problems of integrity of information systems in managing the project BG05M20P001-2.002 "Students practice – Phase I". The management of each project requires and demands serious information security. It is possible to achieve through the extraction and use of data from different information systems and databases. The paper draws attention to technological and architectural features to integrate several software applications to be used in the process of concluding and managing contracts for students, as well as the verification process. The paper showcases sample screens from such systems and draws in conclusion recommendations.

Keywords. Software integration, Software platform, Higher education

1. Main information system of the project

Organization of activities under the project BG05M20P001-2.002 "Student Practices - Phase 1" under the Operational Program "Science and education for smart growth" 2014-2020 is possible in specially built system at http://praktiki.mon.bg/sp [1]. This web-based platform provides almost entirely electronic application process, monitoring, management, cost accounting and verifying them. Fig. 1 presents a screen of the platform of the project.

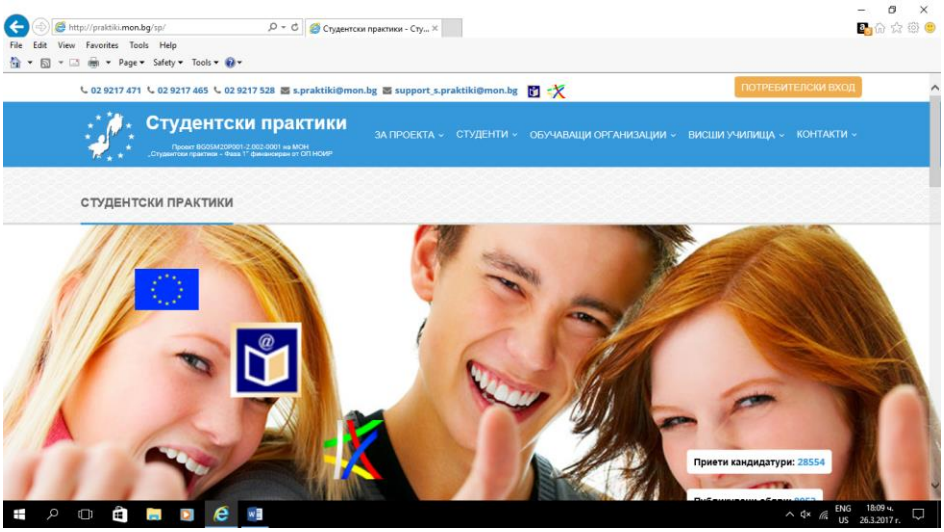

Fig. 1 Sample screen of the main information system of the project

Web-based information system offers opportunities for management of many of the processes for conducting and reporting on practical training of students. In particular, these are:

- User Account Control experts from universities and academic mentors;
- Tracking processes for the preparation of contracts for students;
- Upload documents to the participants in the system;
- Reporting on the activities carried out by the participants;
- Generation of payment documents and more.

Though the platform provides the bulk of the business processes in the management of the project, the universities appear to have the challenge to use other software applications as well.

2. Additional software solutions for contracting students for practical training and verification of costs

The potential for the design and implementation of additional software applications to support project activities is implemented for the following reasons:

- Need for constant checking and monitoring of student status to applicant students;
- Secretarial service processes for granting contracts from organizations – employers, mentors and students;
- Information service of process of verification of student placements of academic mentors;
- Ensuring the maintenance of a database with records of mentors;
- Monitoring the implementation of indicative budgets and expenditure planning, etc.

There are publications in the area of public services, which presents sample screens of software solutions for management of processes in student practices, namely by Kirilova [2], where the accent is placed on the predecessor of the project "Student practices – Phase I". Also, there are publications in the field of information technologies by Milev, in which the focus is placed on the possibilities for an assessment of information systems by different reasons, including the reasons mentioned [3]. Fig. 2 presents a sample screen from the system of University of National and World Economy for verifying and monitoring the students' status.

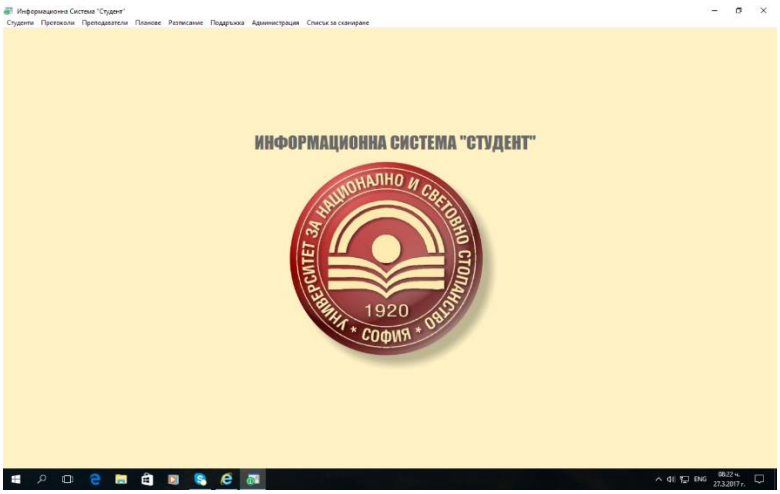

Fig. 2 Sample screen of the system for checking the students' status

The information system is the property of University of National and World Economy and it is used in the project "Students practice – Phase I" in terms of verification of current status of students. Requirement of the project is it to engage students, enrolled in regular status. Another information system, that was developed specifically for the project, is designed to ensure the process of filing services to employers and students. Fig. 3 presents a sample screen of the information system for filing service of contracts.

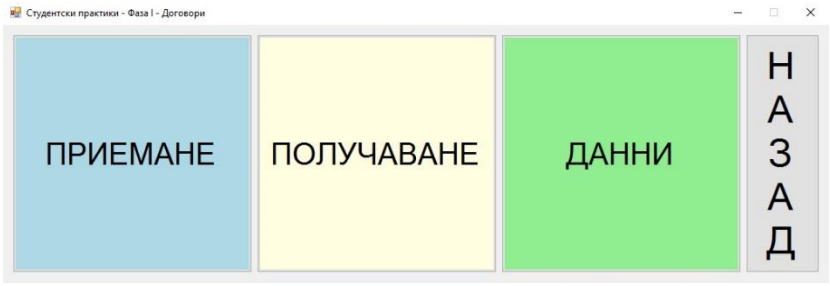

Fig. 3 Sample screen of the system for filing service of contracts

Part of the control mechanisms of the project relate to spot checks of practitioners' students. To enable the public register of inspections, participants in the project have developed a self-web-based application. Fig. 4 is presents a sample screen of the information system for verification of student placements by academic mentors.

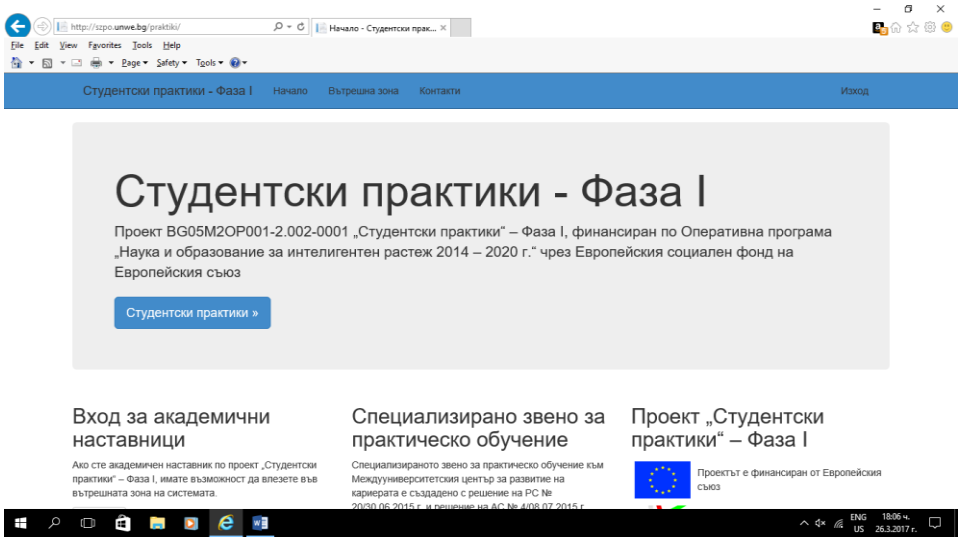

Fig. 4 Sample screen of the system for verification of student placements by academic mentors

Program realization of such a solution is complicated and long process. In this process, all predefined requirements are translated into program implementation. Fig. 5 presents fragments of the source code of the system.

This study presents some short functionalities of several specially developed software applications to manage some of the identified business processes. In a result of these implementations, we can draw conclusions and recommendations for future improvement.

```
LiteDatabase db = new LiteDatabase(Server.MapPath("~/App_Data") + @"/" +
LITEDB_SITE);
      using (db)
      {
         LiteCollection<Preceptor> preceptors =
db.GetCollection<Preceptor>(PRECEPTOR);
         List<Preceptor> list = preceptors.FindAll().ToList();
         DataTable dataTable = new DataTable("Preceptors");
         for (int i = 0; i < list.Count; i++)
         {
            Preceptor b = list[i];
            DataRow tableRow = dataTable.NewRow();
            tableRow[0] = b.IdNumber;
            tableRow[1] = b.Name1 + " " + b.Name2 + " " + b.Name3;
            LiteCollection<BusinessCheck> checks =
db.GetCollection<BusinessCheck>(BUSINESS_CHECK);
            List<BusinessCheck> _bc = checks.Find(Query.EQ("PreceptorIdNumber",
b.IdNumber)).ToList();
            int checksCount = 0;
            for (int k = 0; k < _bc.Count; k++)
            {
               checksCount++;
            }
            tableRow[2] = checksCount;
            dataTable.Rows.Add(tableRow);
         }
      }
```

Fig. 5 Source code of a relationship between academic mentors and verifications performed

3. Conclusion

As a result of the research we can draw the following conclusions:

- For a successful management of project activities, it is necessary to build a whole complex of additional software applications;
- Design and programming of information systems should be carried out in compliance with the previously set conditions for integration into their functionality;
- Developing its own integrated information system in every university leads to facilitating project activities, that can be provided for the safe conduct of the management processes of this and other similar projects.

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Trends in E-government in the European Union

Katia Kirilova

University of National and World Economy, Sofia, Bulgaria
kstrahilova@abv.bg

Abstract. This study is dedicated to the pace of development of e-government in the European Union. The paper presents values for four groups of countries in Europe, according to the methodology of measuring the overall index for the development of e-government at the UN. The paper analyzes the values of the countries with the highest index in the group and performs a comparative analysis for the period 2014 – 2016. At the conclusion the author formulates final thoughts.

Keywords. E-government, European Union, public administration.

1. EGDI values in the European Union

According to the United Nations level of development of e-government in European countries, the average European value for 2016 is 0.7241 [1]. It is higher than the value of America - 0.5245, and the values of Asia, Oceania and Africa (0.5132, 0.4154, 0.2882). Comparative analysis is presented at Fig. 1.

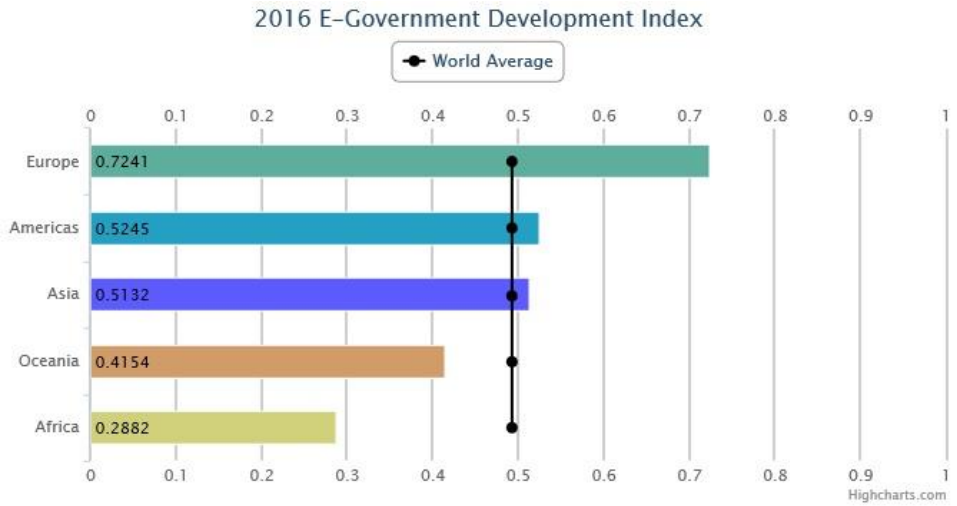


Fig. 1 EGDI values of Europe, America, Asia, Oceania and Africa for 2016

The European average for 2016 has different components in terms of countries, for which it is measured. In particular, these components are represented at Fig. 2:

- Northern Europe
- Western Europe;
- South Europe;
- Eastern Europe.

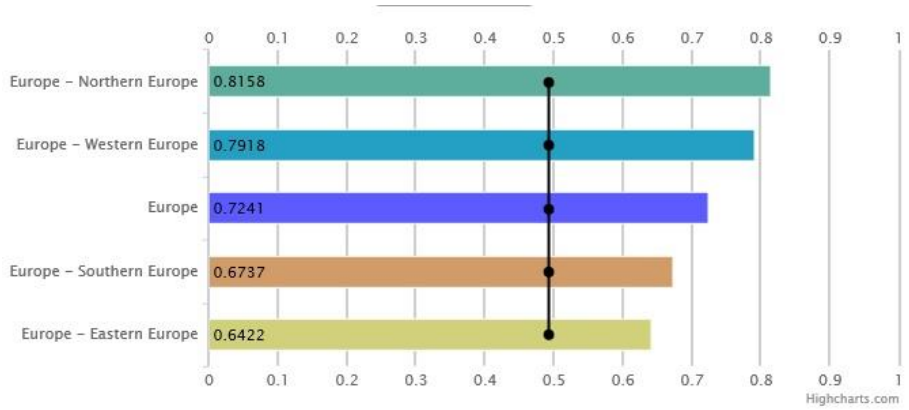


Fig. 2 Components of EGDI for Europe – 2016

The value for 2016 of overall index EGDI are as follows: for the countries of northern Europe - 0.8158; for the countries of western Europe 0.7918; for southern European countries 0.6737 and for the countries of eastern Europe 0.6422 [2]. It should be noted, that some of these countries are not members of the European Union, but because of the peculiarities of the UN study are included in the overall results. From the data it can be concluded, that the countries of Northern Europe have very strong development of e-government systems. Some of these countries with the highest values of the index are: UK - 0.9193, Finland - 0.8817, Sweden - 0.8704, Denmark - 0.8510, Estonia - 0.8334 and others. The second group of countries - western Europe with the highest levels of the index are: Netherlands - 0.8659, France - 0.8456, Germany - 0.8210, Austria - 0.8208 and others (Fig. 3

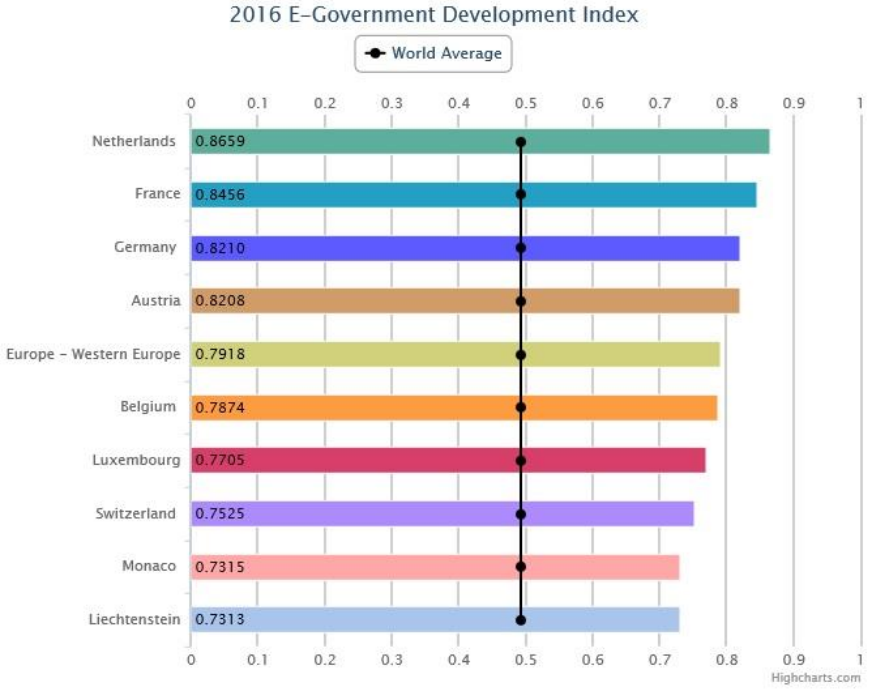


Fig. 3 EGDI values of the countries of Western Europe – 2016

Representatives of the group of countries of southern Europe with the highest levels of EGDI for 2016 are: Spain - 0.8135, Slovenia - 0.7769, Italy - 0.7764, Malta - 0.7424 and others.

Eastern European countries are characterized by the least development of e-government systems and thus with the lowest levels of total index for the development of e-government - EGDI (Fig. 4).

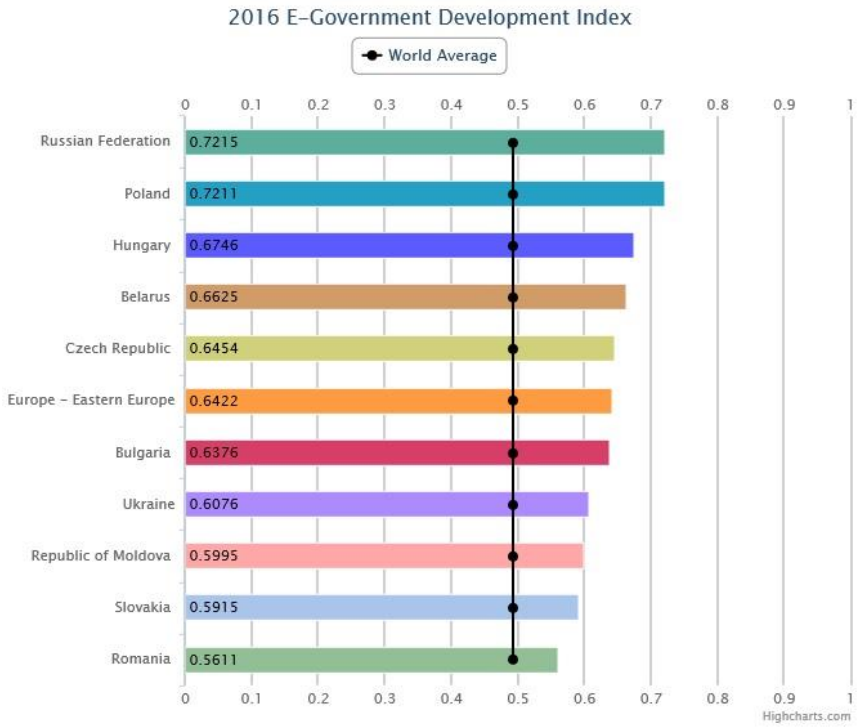
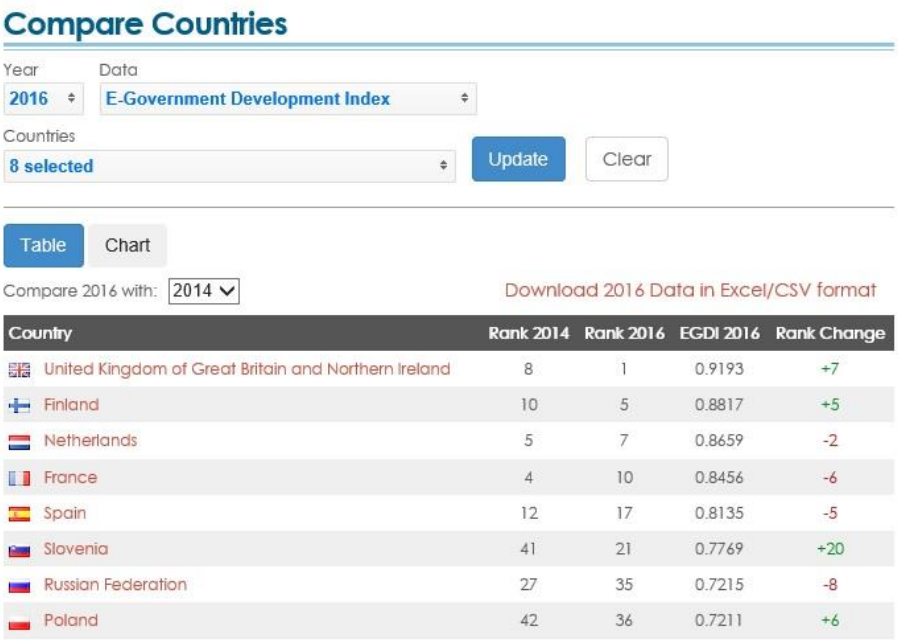


Fig. 4 EGDI values of the countries of eastern Europe – 2016

Some of the countries, that have the highest values of the index in this group: Russian Federation - 0.7215, Poland - 0.7211, Hungary - 0.6746, Belarus - 0.6625, Czech Republic - 0.6454, etc. For 2016 the value of Bulgaria is 0.6376.

2. Development trends of e-government

In order to indicate trends in e-government in the countries of Europe, we will make a comparative analysis for the values in 8 countries (which are leaders in their group). In particular, these are the UK and Finland, as representatives of northern Europe; Holland and France, as representatives of western Europe; Spain and Slovenia, as representatives of southern Europe and the Russian Federation and Poland, as representatives of eastern Europe. The questions, related to the assessment of online services and their convergence, are part of the works of many authors in the field of information technologies [3, 4]. In our case, countries are compared in their data for 2014 and 2016 and the results are presented in Fig. 5.



Compare Countries

Year: 2016 | Data: E-Government Development Index

Countries: 8 selected | Update | Clear

Table | Chart

Compare 2016 with: 2014

Download 2016 Data in Excel/CSV format

Country	Rank 2014	Rank 2016	EGDI 2016	Rank Change
United Kingdom of Great Britain and Northern Ireland	8	1	0.9193	+7
Finland	10	5	0.8817	+5
Netherlands	5	7	0.8659	-2
France	4	10	0.8456	-6
Spain	12	17	0.8135	-5
Slovenia	41	21	0.7769	+20
Russian Federation	27	35	0.7215	-8
Poland	42	36	0.7211	+6

Fig. 5 Key trends – 2014 and 2016

As it may be seen from the data presented, in some countries the trend is clearly more positive, as they have increased the value of their total index for the period 2014 – 2016. These are the UK, Finland, Slovenia and Poland. The other four countries have reduced the value of their total index for the period 2014 – 2016. The most significant improvement is for the UK, which in 2014 is at eighth place in Europe, and in 2016 – at first.

3. Conclusion

As a result of the research we can draw the following conclusions:

- It cannot be identified clear trends in e-government in the four parts of Europe;
- In some countries investment in IT infrastructure and development of electronic services have led to serious shift in ranking the value of EGDI.

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Comparative Analysis of Electronic Services in the Municipalities of Southwest Region

Katia Kirilova

University of National and World Economy, Sofia, Bulgaria
kstrahilova@abv.bg

Abstract. The paper is dedicated to the pace of development of e-government in the municipalities of southwest region in Bulgaria. It analyzes the results achieved in the computerization of government services during the period from 2003 until 2016. On this basis, the paper presents the results of the study of public awareness on the electronic services in some of the leading municipalities. Finally, the author makes conclusions and recommendations.

Keywords. Electronic administrative services, Public administration, E-government.

1. Development of e-government in Bulgaria in the period 2003 - 2016

The e-government, as part of e-management, in the last 10 years has developed significantly. Still, however, our country lags behind in pace than developed countries. In this study will be presented briefly trends, as well as some of the main problems. In 2014, Bulgaria occupies 73rd place with a total value of index development of e-government, measured by the methodology of the United Nations - 0.5421. In 2016, Bulgaria's 52nd place out of 193 countries concerned with development index of e-government - 0.6376. For the period from 2014 to 2016, Bulgaria was constantly in the group of high development index of 0.50 to 0.75, but goes ahead by 21 positions in the ranking of countries [1].

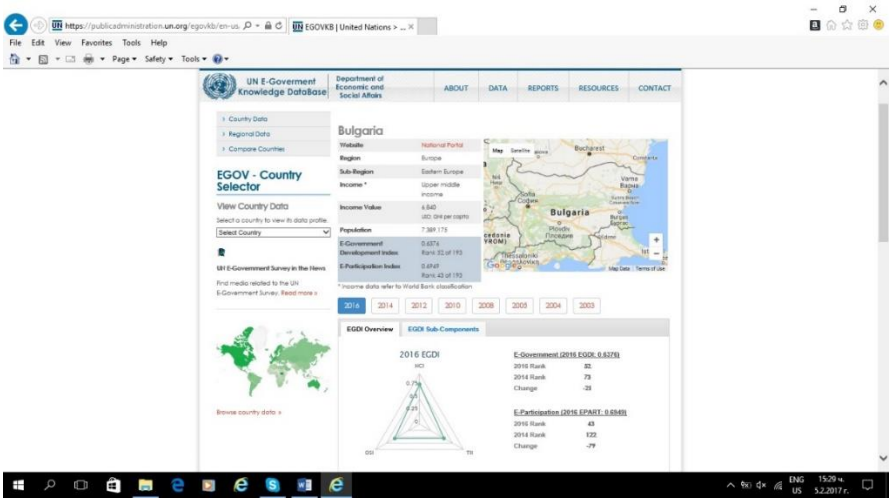

Fig. 1 Index of development of e-government in Bulgaria in 2016

The index of development of e-government in Bulgaria for the period 2003-2016 is presented in Fig. 2 [2].

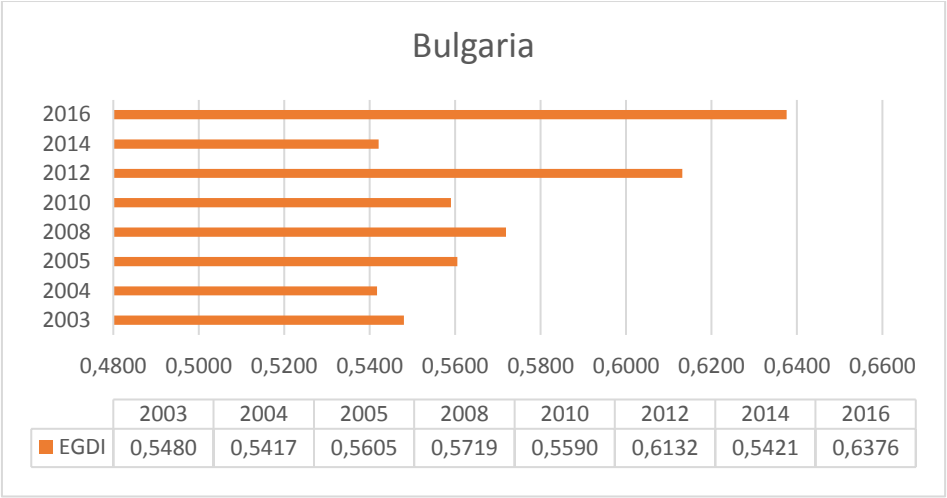

Fig. 2 Index of development of e-government in Bulgaria for the period 2003-2016

As it may be seen from the chart presented, in 2003 the value of EGDI according to the methodology of the UN is 0.5480. Over the next few years until in 2010 the value changed a little and in 2010 it is 0.5590. It may be noted that for seven years this is a marginal increase, mainly due to the slow pace of development of electronic services as part of EGDI. For the period after 2010 it is marked an increase in the value of the complex index, in 2012 it was 0.6132 and it was 0.6376 in 2016.

This positive trend is linked to the investments made in the past few years in the information infrastructure and electronic services, both nationally and locally. Here it comes the topical issue to explore e-services in the municipalities of southwest region, as well as public awareness about them.

2. Development of electronic services in the municipalities of Southwest region

To analyze the level of development of electronic services in the southwest region, it is therefore necessary to develop the methodology of the study. For this particular survey, it includes:

- Choice of target group - users of electronic services;
- Sample selection of municipalities sites that will be investigated by the representatives of the target group;
- Application of a system of indicators to assess the accessibility of the services provided by municipal e-services;
- Presentation of good practices.

For the purpose of the study it was formed a target group of users of electronic services, including 107 students, domiciled in the municipalities of southwest region. There are academic publications about analyzing web content automatically, but for the purposes of this study, it is decided this analyze to be done by the target group of users, although there are lots of advantages of using information technologies [3]. So are defined the 12 municipalities

within the sample, namely: Sofia, Svoge, Bozhurishte, Pernik, Radomir, Breznik, Kyustendil, Dupnitsa, Rila, Blagoevgrad, Bansko and Sandanski. We can define the following indicators to assess the level of development of electronic services in the municipalities:

- Announcements;
- Local taxes and fees;
- Budget;
- Public register;
- Forms and documents;
- Complex administrative services;
- Customer charter;
- Commercial register;
- Information Services and technologies;
- Information services for childcare;
- Public mediator (Lodging of appeals);
- Signals for corruption;
- Questions to the departments of municipality;
- Schedules for transport.

The survey results are presented in Fig. 3.

Region	Sofia			Pernik			Kyustendil			Blagoevgrad		
Municipality	*Sofia*	*Svoge*	*Bozhurishte*	*Pernik*	*Breznik*	*Radomir*	*Kyustendil*	*Dupnitsa*	*Rila*	*Blagoevgrad*	*Bansko*	*Sandanski*
Announcements	x	x	x	x		x	x	x	x		x	x
Local taxes and fees	x	x	x	x	x	x	x	x	x	x	x	x
Budget	x	x	x	x	x	x	x	x	x	x	x	x
Public register	x	x			x					x	x	x
Forms and documents	x	x	x	x	x	x	x			x	x	x
Complex administrative services	x	x	x	x	x	x	x		x	x	x	x
Customer charter	x		x			x	x		x	x	x	x
Commercial register	x						x			x	x	x
Information Services and technologies	x											
Information services for childcare	x											
Public mediator (Lodging of appeals)	x		x							x	x	
Signals for corruption	x		x	x	x	x	x			x		
Questions to the departments of municipality				x			x					
Schedules for transort	x		x	x	x		x					

Fig. 3 Results from this survey of 12 municipalities

From the data it is clear, that some municipalities cover some of the indicators, but others have no information on their sites. There are articles, dedicated to the problems of software solutions for project management and the ways of providing comparative analysis [4]. To make it possible to perform a comparison between different municipalities it is made a grouping of the received data and the results are given in Fig. 4.

Criterion	*Number of municipalities*
Announcements	10
Local taxes and fees	12
Budget	12
Public register	6
Forms and documents	10
Complex administrative services	11
Customer charter	8
Commercial register	5
Information Services and technologies	1
Information services for childcare	1
Public mediator (Lodging of appeals)	4
Signals for corruption	7
Questions to the departments of municipality	2
Schedules for transort	5

Fig. 4 Grouping of municipalities by provided electronic services

Based on this grouping, we can make the following conclusions:

- Announcements are offered by the sites in 10 municipalities;
- Information about local taxes is provided by 12 municipalities;
- Complex administrative services can be found at the sites of the 11 municipalities;
- Forms and documents are available in 10 municipal sites.

3. Conclusion

As a result of the research we can draw the following conclusions:

- The sites of the municipalities of southwest region offer a variety of electronic services to help citizens and businesses;
- In some of the sites cannot yet be found the necessary information, which requires the expansion of electronic services;
- It is necessary to achieve ever higher levels of EGDI national plan, through investments in IT infrastructure and electronic services.

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Features of Web Platforms for Implementation of Message Boards

Plamen Milev

University of National and World Economy, Sofia, Bulgaria
pmilev@unwe.bg

Abstract. The paper examines the main platforms used for implementation of message boards. Under platform we understand web based systems, which implement the functionality of a message board. The paper defines the characteristics of the platforms in their meaning of information systems. Each platform is modeled with a specific html code. Based on the analysis, the selected platforms are categorized by common html characteristics.

Keywords. Message board, Internet, Web platform

1. Introduction

Modern message boards on the Internet originate from so-called bulletin boards and newsgroups. These environments allow people to send messages and comment on messages. Participant in such an environment puts a dashboard message, which is visible to all participants in this environment. Once the message is read, it is possible to be replied and these replies are also visible to all participants. It can be formed discussion this way and it doesn't matter whether customers are at this point at the same time. From a technological standpoint message boards are web applications that manage user-oriented content. Messages are organized into discussion categories or topics, chosen by the host (the creator of the message board) or by a participant in it. Depending on the organization of the message board, the participants in the discussions are set by the board administrator with their rights to send reply messages or start new discussions. Users of the message board can be anonymous (if authorized by the board administrator) or registered with a selected unique within the message board system username.

2. Components of message boards

To determine the platform features of message boards we should define the term component. In the sense of this study, a component is a container (part of the user interface of an application), which stores a particular type of information. In a web page usually there are many different containers, but only certain of them can be used to correctly extract necessary for the essence of this study information. The aim of the paper is to identify the platform features of message boards on the web, that can serve to automate the following process to extract data from these message boards. Based on a study and analysis of a sample of message boards, we are able to define the following components of a message board, some of them may not be present in every message board:

- Clock, showing the current date and time – an important component using a server time of the message board to determine the date and time of some important events, that take into account the implementation of the algorithm for retrieving data. For example, in some message boards date of a publication of topic or post (message) is not in the form

"day, month, year, time", but it is in the form "Before 5 minutes," "Yesterday, 15:20", "Yesterday, 17:30", etc. In this case it is important to have the server time of the message board in order to determine the date (day, month, year) and time (hours, minutes, seconds) of the publication;

- List of forums (which refer to pages, each of which contains a list of topics) – fundamental component, that stores information in tabular format about the forum name, web address, number of topics in the forum (optional), number of posts in the forum (optional), last publication – contains information about the username of the last user, who posted a message and the date of this publication;
- List of topics – fundamental component, that stores information in tabular form about the topics within a forum, including information about the name of the topic, web address, number of posts in the topic (optional), number of views of the topic (optional), last publication – contains information about the username of the last user, who posted a message and the date of this publication;
- List of posts – fundamental component, that stores information about posts themselves within a topic, including information about the name of the user, who wrote the post, content of the post, publication date, signature (optional), web address to the avatar of this user (optional);
- Paging – fundamental component, that stores information about web addresses (links) to pages to a forum or a topic and that contains information about the number of the current page, number of the next page (next pages, if any), web address (link) of the next page.

3. User interface of message boards

Researches on various message boards allow us to define three main interfaces that are presented in web-based applications of this type:

- Interface with lists of forums. It shows the categorization of topics within a message board. Each section can be divided into subsections. These are the names of forums. This interface must store a component for a list of forums. The component clock may appear, but it is not a mandatory one. A graphic description of this interface is shown at Fig. 1;

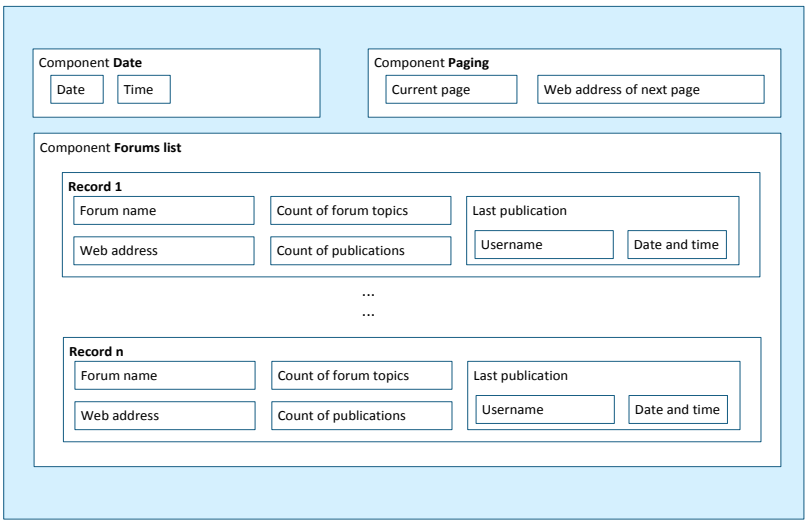

Fig. 1 Forums

- Interface with lists of topics. This interface shows a list of topics subjects, that belong to a concrete forum. It must store component for a list of topics. The component clock may appear, but it is not a mandatory one. The component for a list of forums may also be presented. The component paging appears almost always. Exceptions are those cases, in which a full list of topics fits on one page (the number of topics to the relevant subsection is less than or equal to the configured web platform maximum number of items per page). A graphic description of this interface is shown at Fig. 2;

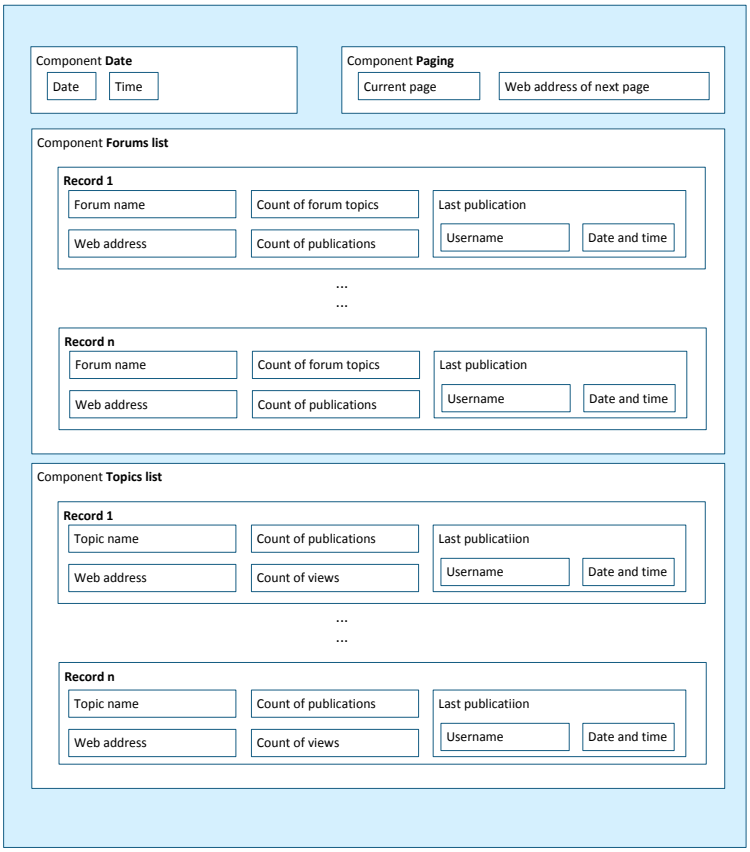

Fig. 2 Topics

- Interface with lists of publications. It shows posts of users on a given topic. The component list of publications (posts) appears necessarily. The component clock may be presented, but it is not a mandatory one. The component paging appears almost always. Exceptions are cases, in which a complete list of posts fits on one page (the number of all publications on the topic is less than or equal to the configured web platform maximum number of items per page). A graphic description of this interface is shown at Fig. 3.

4. Technologies for implementation of message boards

Overall, most message boards are using one of the many specialized web systems for creation of a message board, but there are sites that use their own system for implementing a

message board and these are mainly corporate news sites. Issues, related to development and management of software solutions in the form of web-based platforms for public services have been investigated by different authors [1, 2]. Currently, the most used technologies (languages) for web development are PHP, which is open source and ASP/ASP.NET technology owned by Microsoft. The other languages (technologies) for web programming, whether open source or owned by a company, are located with much less use.

According to the Forum Software [3] the ten most used software systems for making a message board are ranked in the following order:

- XenForo (http://xenforo.com/);
- IP.Board (http://www.invisionpower.com/apps/board/);
- Burning Board(http://www.woltlab.com/wbb/);
- MyBB (http://www.mybb.com/);
- PhpBB (http://www.phpbb.com/);
- Vanilla Message boards (http://www.vanillamessage boards.org/);
- ZetaBoards (http://www.zetaboards.com/);
- FusionBB (http://www.fusionbb.com/);
- Lefora (http://www.lefora.com/);
- vBulletin (http://www.vbulletin.com/).

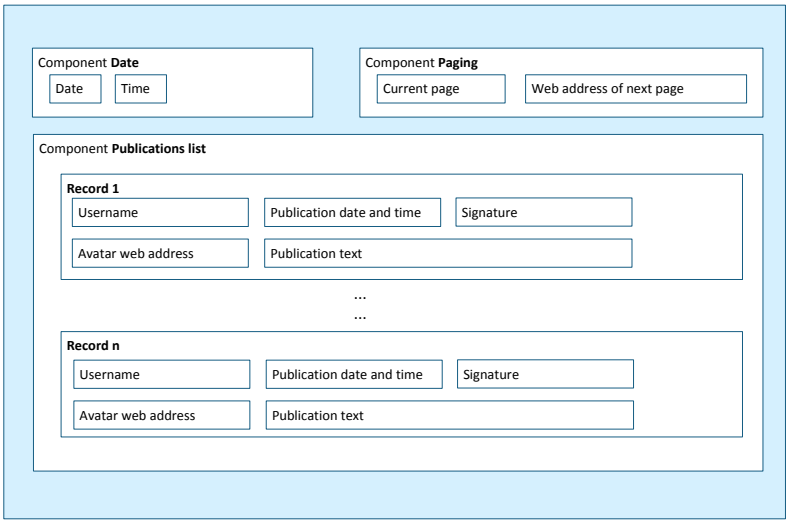

Fig. 3 Posts

5. Conclusion

In conclusion it can be said that the platforms for message boards have differences, basically in their user interface, due to differences in programming styles in development of relevant message boards. At the same time, from the structural point of view, message boards have many common functionalities.

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Components for Assessment and Rating of Online Discussion Sites

Plamen Milev

University of National and World Economy, Sofia, Bulgaria
pmilev@unwe.bg

Abstract. The paper examines the status and technical specifications of online discussion sites in Bulgaria and presents a methodology for evaluation of popularity of these online discussion sites. The methodology is based on different components and indicators by which it can be determined how popular a given online discussion site is. In conclusion, based on the specific values of these components and indicators for specific online discussion sites, some of the most popular online discussion sites in Bulgaria are defined.

Keywords. Online discussion site, Internet, Web traffic

1. Introduction

The expansion of the Internet led to change in people's lives – the network has not only improved the opportunities for access to information of all kinds and at any time, but also has changed social aspects of behavior and communication of active users. One of the most popular examples of social network is Facebook, which has nearly 1 billion subscribers worldwide. This social network and also other social networks (Twitter, Google+, etc.) provide opportunities to build relationships between people, in which individuals share their interests over their activities and details of their personal life. Another very popular mode of social interaction is the participation of people in online discussion sites. The main purpose of online discussion sites is to provide a place where people can exchange views and discuss specific topics. Despite the difficult of assessing how many people use online discussion sites, according to the Quora in year 2010 their number amounts to about 300 million people [1]. The popularity of online discussion sites is also based on the fact that they are creating a virtual community of regular participants.

2. Essentials of online discussion sites

An online discussion site generally consists of three components (fig. 1):

- Forums;
- Topics (sometime called threads);
- Posts (messages).

These components generally have a tree structure. Forums are managed by the owner of the online discussion site. Topics and posts can be managed by the so-called moderators.

Online discussion sites can be free or paid. Each online discussion site can have an unlimited (so much so allow the technical parameters of the platform) number of forums. The forums are the place where topics of discussions and posts are stored. At the home page of the online discussion sites there is a list of all forums to which the user has access. Same can see the number of topics on which there is a discussion in each forum, date, time and author of last post (reply, comment) in each forum. The post is the last, but not least component and it is the

reason for the existence of an online discussion site. Each post is submitted by a user of the online discussion site with given date and time at which the post is created. Post, which is a response to another post, and subsequent posts form the so-called thread. Posts often have an upper limit to the amount of characters that can represent them, but it is rarely reached because it is in the range between 10000 and 50000 characters for most online discussion sites. When there are new posts from the last consideration, an indication of this is given, so the user can decide whether to review any forum, because there is a new post there or not.

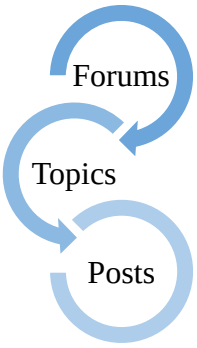

Fig. 1 Elements of online discussion sites

Number of topics in popular online discussion sites in Bulgaria is enormous. Based on observations of over 200 examined online discussion sites, we can distinguish the following leading thematic areas of online discussion sites (fig. 2):

- Politics and news (affects these topics both Bulgaria and abroad);
- Economics (affects topics about banks, money, investments, business, accounting, etc.);
- Health (food, recipes, doctors, hospitals, restaurants, drinks, environment, etc.);
- Sport (football, volleyball, tennis, etc.);
- Dating and social networking (community, exchange of views without certain topics, etc.);
- Tourism and travel (geography, maps, countries, cities, etc.);
- Art and culture (music, cinema, theater, concerts, books, etc.);
- Religion (teachings, mysticism);
- Technology (computers, Internet, hardware, etc.);
- Science and education (schools, universities, textbooks and teaching materials, etc.);
- Entertainment and lifestyle (affects hobby, cars, home, garden, shopping, etc.).

3. Assessment and rating of online discussion sites

The assessment of popularity of online discussion sites should contain the following components (fig. 3):

- Web traffic, which is implemented in user access to the relevant pages;
- Number of unique visitors for a certain time;
- References from other websites to the given online discussion site.

Statistics for these components are available through studies of companies such as Alexa and Google, who own systems for determining popularity of a site. Web traffic is representing the amount of data that is exchanged through any website. It is a large part of the global Internet traffic. Web traffic is determined through the number of visitors and the number

of pages they visit. Websites monitor incoming and outgoing traffic to determine which departments or pages are most visited and whether there are specific trends, such as if a particular page is popular with visitors from a specific country. There are many ways to monitor the traffic and the collected information is used for making better structure of the website, finding security problems or indicating a potential lack of bandwidth, because not all types of web traffic is welcome.

Fig. 2 Main thematic areas of online discussion sites

Some companies offer promotional plans where they pay for a place on a webpage for an increase in web traffic. Opportunities for measuring of services on the web and different approaches for development of business applications are part of the work of many authors [2, 3]. Websites often aim to increase their web traffic by being included in the search engines and through search engine optimization. The analysis of web traffic is a measurement of the behavior of visitors to a website. From a commercial point of view, the analysis often leads to determining which sectors of website support the objectives of internet marketing, such as which pages encourage customers to make a purchase.

Fig. 3 Components for assessment of popularity of online discussion sites

Web traffic is measured in order to determine attendance of websites, parts of a website or certain pages within a website. Web traffic can be analyzed by viewing the traffic statistics that are in the server log. Visit or impression is generated when the visitor opens at least one page in a website - a visitor will always generate at least one impression but could generate more. For evaluation of the component web traffic, we can define the following indicators (fig. 4):

- Number of visitors;
- Average number of impressions per visitor – a high number suggests that visitors deepen the website;
- Average length of visit – the duration of stay of the visitor;
- Average length of page – how long is viewed a particular page within a website;

- Busy times – the time when the website is visited most would be the best time for promotional campaigns and the where visits are decreased would be the best time for the maintenance of the website;
- Most requested pages – the most visited pages;
- Best path – the sequence of visited pages from start to finish, identifying the way in which most visitors pass through the website.

Fig. 4 Indicators of the component web traffic

The amount of traffic to a given website is a measure of its popularity. By analyzing the statistics, it is possible to find weak spots on the website and therefore find a way these units to be improved. It is also possible to increase visits to the website. Sometimes it is advisable the access to certain sections of the website to be protected with a password that allows only authorized people to visit certain sites. Some administrators of websites can decide to restrict access to web pages in any other way, such as geographic location. Web traffic can be acquired in several ways. Achieving a high ranking in the search engines for given keywords can easily attract new visitors. Of great importance at this point are the structuring of the website and its authenticity. Web traffic can be increased by the inclusion of a website in search engines and by purchase of advertising. Web traffic can also be increased through the purchase of advertising beyond the Internet. If a web page is not found in the top of search results, chances for this page to be found are drastically reduced. Very few people go to the second page of search results when looking for something and the next rate (going to third page, fourth page, etc.) is even lower. Therefore, the placement of the website is almost as important as the website itself. Web traffic which comes from unpaid search engine results or web directories is called limited web traffic. It is generated and can be increased by including the website in directories, search engines, guides (such as the yellow pages) or websites with prizes. In most cases, the best way to increase web traffic is to register the website with the major search engines. The registration itself does not guarantee visits as search engine are indexing information through a certain algorithm. Too much web traffic can dramatically slow down or even prevent access to the website. This is caused by too many requests for files sent to the server, more than the server can handle. The reason for this can be great reputation of the web page or targeted attack. Large websites use multiple servers and can serve all requests, so overloading is common for small websites. There are several main types of sources of web traffic:

- Traffic generated by web search engines – in this case a web resource is accessed by Internet users who seek information and find pages of this source in the search results (sample search engines are Google, Bing, Yahoo, etc.);
- Direct traffic – traffic that is carried out through direct access to web sources. In this case, users usually know in advance the web address of the source and direct access its pages;
- Redirected traffic – implemented by the external references from other relevant websites to a given website.

One of the leading systems for ranking websites is that of the Alexa [4]. This is a ranking system set by alexa.com (a subsidiary of amazon.com), which mainly carries out audits and makes public the frequency of visits to various websites. Algorithm whereby Alexa traffic rank is calculated is simple. It is based on the amount of traffic, registered by users who have installed instrument Alexa (toolbar) for a period of three months. This traffic is based on parameters such as range and viewing pages. The scope refers to the number of users (using the tool of Alexa), who visit pages on a site in one day. Page views indicate how many times a page (Internet address, URL) is viewed by users of Alexa. According to the methodology of Alexa, if a user visits the same URL address several times within the same day, all those visits will be counted as one. Alexa ranking is obtained based on the average range and page views over a period of time.

4. Conclusion

In conclusion it can be said that the assessment and rating of online discussion sites play an important role in existence of these sites and their maintenance. Based on the methodology in this study we can determine some of the most popular online discussion sites in Bulgaria and these are bg.pockerstategy.com, www.bg-mamma.com, www.bmwpower-bg.net, www.bul-mamma.com, www.data.bg, www.hardwarebg.com, www.kaldata.com, www.mercedes-bulgaria.com, www.segabg.com and www.stringmeteo.com.

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Optimization Methods for Performance - Critical Multiplatform Communication and Social Network Applications

Venko Andonov

University of National and World Economy, Sofia, Bulgaria
vandonov@unwe.bg

Abstract. The technologies for the development of multiplatform applications (based on JavaScript) provide strong benefits for the speed of the implementation iterations and the rapid response to change of requirements. However, the trade-off is the decreased performance of the applications compared to the use of native development platforms. Multiple optimization methods are being evaluated as possible mechanisms to achieve better performance in the context of communication and social network mobile applications, which require low latency.

Keywords. Mobile communication, Performance optimization, Social Network

1. Introduction

The development of software applications for multiple platforms is accepted as a very important requirement in a world full of different devices and operating systems. The development of software products is expected to cover at least some of the following environments: desktop computers, smartphones, tablets, smartwatches. The different operating systems (and their different versions) further complicate the development lifecycle and increase the necessary resources for building a useful, modern system [1, 2, 3].

The most feasible approach (especially in the context of limited resources) is building a multiplatform application based on a smaller development stack. This allows for smaller teams to cover the different platforms and operating systems. The significant amount of code reusability is beneficial as well, as the development could focus more on the specifics of the application rather than the platform specifics.

The requirements from the point of view of the users of a system include: near real-time responsiveness, low network latency, well-accepted user experience patterns, familiar graphical interface and overall experience on every device. From the point of view of the development, it is necessary to create a highly responsive graphical interface, to optimize the network communication, to consider the server-side performance and to take advantage of the shared codebase.

The typical approaches for the development of multiplatform applications are: separate native development; web pages in an embedded web rendering component; single codebase, built for each platform. If a system is developed separately for each platform (for example, Android, iOS, Windows) the developers have a single set of requirements and multiple development lifecycles. Using web technologies (like Apache Cordova) is much more efficient from organizational point of view but the downsides include less flexibility and lower performance [4]. The third approach uses a single development platform (for example Xamarin and React Native) which are compiled as native applications and it is possible to share significant parts of the codebase.

2. Performance of Multiplatform Applications

The performance of communication and social network applications can be evaluated using the following metrics: application startup speed; resume speed (the time necessary to restore the application state after a period of no usage); rendering speed (the time necessary to display a given screen on the device); communication speed (the time necessary to deliver a message from/to a server); battery usage on mobile devices [1].

For the purposes of this research, the focus is put on the performance of a client of a communication and social network system. The performance measurement includes: profiling the execution time of internal functions; timing events; memory snapshots; network latency [1, 5, 6].

Each development platform has its own set of preferred tools to measure and analyze performance. For example, in Android, the Android Monitor inside Android Studio is a very powerful tool to observe the behavior of the developed application. For the web-technology based solutions like Cordova, the Chrome DevTools provides the necessary set of tools to analyze the performance in terms of processing speed, memory, rendering and network latency [7, 8].

3. Optimization Methods and Approaches

In the context of the development of multiplatform communication and social network application using web-based technologies in an embedded rendering engine, the possible optimizations are in the following categories:

HTML/DOM optimizations; JavaScript code optimizations; network communication optimizations; development of native plugins [2, 3, 4, 5].

The first implementation method is reducing the overall number of DOM elements on each rendered page. Simplified DOM leads to less processing during the rendering phase. The second method is to avoid the redrawing of the DOM inside a loop – for example, if it is necessary to move some elements around the screen, their current positions should be stored simultaneously beforehand.

Another method is to display large list partially – only the part of the list which is directly visible at a given moment. In the case of a social network application, the visual appeal might be important and that is why it should be noted that it is preferred to use CSS3 animations over JavaScript ones. In the case of color gradients, using images is the preferred method.

When multiple elements on a page have identical event listeners, it is necessary to try to use a single listener instead of separate ones. Absolute over relative positioning is preferred as well.

To reduce the amount of network traffic and keep battery usage low (especially on 3G/4G networks), the approaches are: to use offline storage if possible; use compression for data transfer; minimize the size of the transferred data (for example by using a serialization format with less overhead, like JSON rather than XML); fetch as much necessary data as possible in a single web request.

4. Evaluation and Results

The research context is the design and development of a custom contextual social network application which needs to be available on multiple platforms. As a communication and social network application, it has to meet the performance expectations of the end users. The features of a custom social network application might include: creating and participating

in groups; displaying news feeds; calendar management and sharing; link, file and photo sharing; personal and public discussions; content ratings. For the evaluation purposes of a client application, the profile display of a single user is being tested. This screen (activity) includes basic profile details, photo, information about connections and recently shared content (text, links, etc.).

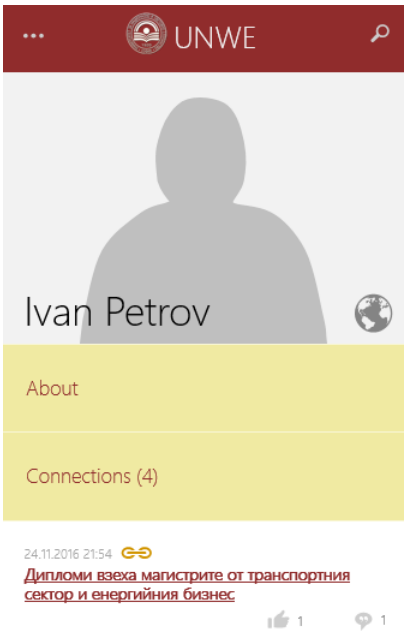

Figure 7: Custom social network profile on a mobile device

Three indicators are measured for each of the selected use cases: time from calling the action to its final rendering; difference of application memory usage; network traffic. Additionally, each use case is tested in an optimized and non-optimized version.

Table 1: Performance evaluation results

Use case	Time from call to render	Memory usage difference	Network traffic
Profile display – non-optimized version	1450ms	6MB	502KB
Profile display – optimized version	1221ms	5MB	398KB
Connections display (list) – non-optimized version	1280ms	9MB	585KB
Connections display (list) – optimized version	1150ms	8MB	490KB

The optimized versions follow the principles: simplified DOM structure; attaching single event handlers to multiple elements; minifying and compressing CSS, JavaScript files and the images; combining multiple resources into single file in order to minimize the number of requests.

The performance optimizations on web-based multiplatform application (in this case based on Apache Cordova) are a promising method to reduce the overall development effort without sacrificing the user experience and satisfaction.

A systematic approach of the analysis and application of web-based multiplatform applications allows for the development of automatic or semi-automatic toolset to improve the performance without the need for deep knowledge into the specifics of the web rendering components.

Acknowledgment

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Cognos Mobile - Dashboards Design and Implementation Technology

Veska Mihova, Geno Stefanov, Maria Marzovanova

University of National and World Economy, Sofia, Bulgaria
vmihova@unwe.bg , genostefanov@unwe.bg , mmarzovanova@unwe.bg

Abstract. This paper reviews certain challenges and issues in designing dashboards for mobile devices. Strengths and weaknesses in potential solution – Cognos, technology for dashboard mobile design and implementation are also reviewed in the current paper. Promising directions for future research are outlined.

Keywords. Business Intelligence, Dashboards, Mobile dashboards, Cognos mobile.

1. Introduction

Today's managers more and more often get out of their offices, and that's why the need of improved mobile communication capabilities arises. The mobile applications for business intelligence make information available when and where it's needed. The workers need mobile business intelligence (mobile BI) data wherever they are to view the necessary information.

Important question is: how do we create BI solutions to be as useful as possible on a mobile device? There are several facets to consider – the end user experience, the tool or the software, and ultimately the development process.

The purpose of this report is to review the certain challenges and issues in designing dashboards for mobile devices in order to outline aspects based on the world popular experience in this area.

In addition, in this paper Cognos as one of the most recognized technology for dashboard design and implementation will be analyzed and its strengths and weaknesses are going to be summarized.

2. Main challenges and issues in designing dashboards for mobile devices

The dashboards designers have complex tasks considering the rapid evolution of tablets and smartphones, which makes the dashboards design and implementation a moving target for them.

Dashboard designers have to understand that just delivering data is not enough, even if it's delivered in modern, highly graphical ways. To get real business value from dashboards, designers need to find ways to pull in end users so they don't simply ignore the data being presented to them [1].

With all those factors at play, Brydges, a managing director at consulting company MorganFranklin in McLean Va, said simplicity is called for on mobile dashboard designs. "Less complicated and less involved dashboards that focus on a subset of critical data will use up less screen real estate and be more portable to mobile devices," he said. [2]

Designers creating BI dashboards for mobile devices must balance the need for functionality with expectations of an optimized mobile user experience.

In any case, mobile BI still faces challenges that have to be successfully addressed to fully realize its benefits. These challenges include meeting user expectations, need for real-time mobile BI, designing for screen size, creating an appropriate technology architecture, and providing security.

a. Meeting User Expectations

Mobile BI makes BI more widespread. Some users will experience BI for the first time; for others, even seasoned BI veterans, receiving BI-related information on their smart devices will be a new experience.

Some users are essentially familiar with smart devices and they have expectations about how applications should look and work. Workers expect the same experience with workplace-oriented apps as they do with consumer-oriented ones.

If companies do not have developers with the mindset, skills, and experience in developing mobile apps, they may need to go outside the firm for the necessary talent.

Because of the user expectations, companies should carefully think about how BI applications are developed. Many companies often treat mobile BI as an extension of desktop BI. With this approach, traditional BI content is reformatted and sent to mobile devices. This approach is problematic. A sophisticated, graphics-heavy screen may look and work great on a desktop computer but be questionable on a tablet and impossible to read on a smartphone. [3]

More companies are making corporate information available to customers in the form of self-service BI applications. To be successful, these self-service BI applications must be as simple and convenient as possible. They should provide non-technical business users the ability to access governed data sources and explore the data themselves. This produces a streamlined and purposeful experience that helps to ensure high adoption and user satisfaction.

b. **The Need for Real-time, Mobile BI**

Another concern about dashboard mobility involves data delivery speeds where the users looking for access to data often want to get it in real or near real time. Adding that supporting such capabilities often requires additional IT infrastructure investments.

Vice presidents need to be able to see current conditions and trends in their business areas to manage deviations and ensure alignment with tactical and strategic initiatives. Executives need current and accurate metrics that provide information about how their corporate goals and vision are being achieved.

c. Security

Historically, information technology groups had complete control over companies' desktop computers—from procurement to set up, maintenance, and replacement. IT controls which computers are purchased, what software runs on them, and how they are secured. This complete control is no longer possible as workers are increasingly bringing their own devices to work and want to use them to access company data.

Whether the users are at the airport, visiting a client, or working at home, mobile devices are essential for getting the answers they need quickly and efficiently. It's critical to know who your target user groups are so you can understand when and where they're likely to access mobile dashboards and reports, and for what purpose.

While there is great convenience in being able to access information at any time, any place, and on any device, it also creates the greatest concern about mobile BI—the fear that

sensitive corporate information might be exposed because a device is lost, stolen, or exposed to viruses, spyware, or malware.

While companies have invested in security that protects all endpoints in their corporate networks and firewalls that prevent unauthorized external access, mobile devices effectively cross through the protective firewalls. When these devices are infected with viruses or Trojan horses, potential security problems are created in corporate networks [4].

The security system on the smart device only allows applications on an approved list to be downloaded.

The policy should strike a balance between the management oversight and security controls that the business and IT require while not imposing procedures and restrictions so severe that they undermine users' needs and productivity.

d. Mobile BI Architecture

There are different possible architectures for mobile BI.

One of the most interesting and important architecture decisions is whether to develop native or web based applications. A native application is standalone software that is designed and optimized to run on a specific mobile device platform. Because the applications are created for a specific platform, it can be designed to use all the features and capabilities that workers expect and need.

Web-based applications run in a Web browser window like on a desktop computer. The applications can be designed in a way, however, that the browser window is embedded in the application and does not appear and the application is accessed as an icon on the user's screen.

HTML5-based web applications' capabilities are advancing rapidly with many similarities to native applications, such as touch-centric graphical interfaces, and limited device control and local data storage. However, well-designed native applications have the potential to be more responsive, more interactive, and more capable as they can better exploit the device hardware and operating system.

While users like native applications, they are more challenging to develop. In contrast, companies typically have people with considerable experience developing web-based applications who can quickly pick up developing mobile applications. These applications can run on any device with a standards-compatible browser.

e. Different Screen size

Finding the proper balance between optimizing the mobile look and feel and delivering the full functionality of dashboards originally designed for desktop computers is one of the main challenges in mobile BI.

Another important challenge that dashboards designers are faced with are multiple platforms with different screen sizes. The corporate executives and other business workers use various mobile devices, which means the dashboards must be complied to run on different platforms and screen size.

Screen size is one of the most significance differences between desktop and mobile BI. Users need to be able to view and work in the size of the screen of their mobile device(s). What is appropriate for a desktop application probably needs to be different for a tablet and most certainly for a smartphone. There is the potential for confusion when users see essentially the same information displayed differently on different devices, but this can be handled through user training.

3. Strengths and weaknesses of Cognos Mobile as technology for mobile dashboard design and implementation.

IBM Cognos Mobile is a Business Intelligence solution for executives and mobile users who require wireless access to important information. IBM Cognos Mobile extends the full value of Cognos 10 Business Intelligence to mobile users requiring timely, personalized and secure information beyond their traditional office. Users can access and interact with reports and dashboards on their mobile device while they are offline or online. It supports standard reports, Active Reports as well as Cognos Workspace content. [5]

The software is designed to enable business users without technical knowledge to extract corporate data, analyze it and assemble reports. The native app can be connected to multiple IBM Cognos Mobile servers.

Cognos is composed of nearly three dozen of software products. Cognos is built on open standards, which allow the software products to access relational and multidimensional data sources from multiple vendors, including Microsoft, NCR Teradata, SAP and Oracle.

a. Strengths of IBM Cognos Mobile

The advantages of any Cognos business intelligence solution are always associated with the richness of functionality and the breadth of features. The strengths of IBM Cognos Mobile can be summarized as follows:

- Uninterrupted productivity - Cognos solutions for a mobile workforce make it possible to ensure that worker productivity is not interrupted, no matter where they are or how they are accessing their BI content.
- Rich, visual and interactive experience—online or off - Users all want the same experience in the work world that they have in the consumer world in terms of interactivity and consistency. Cognos solutions for a mobile workforce provide them with the same experience they get from consumer applications while taking advantage of device-specific gestures and collaborative exchange. Cognos Mobile takes advantage of the all the native functionality of their tablets and smart phones. In addition, they can customize their BI experience by adding individual reports or dashboards to a Favorites list or Welcome screen so they can get their most important information fast.
- Disconnected, portable - The IBM Cognos Mobile native applications offer the ability for users to access their reports while they are offline, making it possible to continue work while traveling or if the device is not within connectivity range.
- Cognos Mobile supports the following Smartphone and Tablet technologies:
    1. iPhone
    2. iPad
    3. Android
    4. BlackBerry
    5. Windows Mobile operating system
- E-Mail a Report - The highlighted version or original version of the report can be emailed to users using the Email option on the top of every report.
- Optimized for touch interface.
- Security - IBM has gone to significant lengths to ensure the security of Cognos Mobile operating on smart phones and tablet devices. Cognos Mobile security is derived from a combination of sources: IBM, the device operating system and the IT department. No matter how users access Cognos Mobile— from a native application or the web—your underlying security base will be the Cognos platform. The Cognos platform provides

integration with enterprise authentication and a central place to control access and authorization for all Cognos Business Intelligence objects, capabilities and data. In addition, the following security possibilities of IBM Cognos Mobile can be outlined:

1. Leverages Cognos security: namespaces, users (e.g. AD, LDAP)
2. Supports web/application server security: TLS/SSL, NTLM, Kerberos, SiteMinder, etc.
3. Communication is standard HTTP and works with standard network security: VPNs, TLS/SSL, secure WiFi, etc.
4. Benefits from device security: PIN password, application sandboxing, OS storage encryption, etc.
5. IBM Cognos Mobile provides an additional 'lease key' mechanism to allow time-limited access to data while offline.
6. Application Passcode can restrict access to the App

b. Weaknesses in Cognos Mobile

The usage of tablet and mobile devices also brings challenges for IT departments. More and more people are bringing personal devices to work which brings security vulnerabilities concerning networks and sensitive data store on tablet devices that need to be addressed. IBM Cognos Mobile is leveraging the existing Cognos BI security and is integrated completely. LDAP authentication is done by the Cognos BI mechanism. All content is encrypted using AES 128 or 256 bit and uses the device PIN to re-encrypt the contents. Support for SSL pinning and client side certificates is available.

Despite all advantages of IBM Cognos mobile, the following weaknesses can be outlined:

- Slow performance with large data sets;

Reason: Active Reports renders the data decks at runtime, encapsulates them into an MHT file, and then sends that file out.

- Cannot export to Excel format

Reason: Active Reports can only export to MHT, which means it is an archive with design & layout information and the data itself saved into one file.

- Cannot use drill through functionality; does not work when Active Reports are viewed off line.

4. Conclusion

Enterprises generate data on a daily basis, business decisions have to be based on that data, but the raw data is simply overwhelming. So data visualization has essentially become indispensable.

Dashboards are effective tools for fostering growth in the digital age. With informed data decision making abilities, businesses can continue to advance with the digital age.

There has always been a need for mobile BI. While the need has always been there, only recently has the technology been available to support mobile BI.

Now the BI market offers various mobile dashboard design and implementation software.

Acknowledgment

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Applying IoT in Education

Geno Stefanov

University of National and World Economy, Sofia, Bulgaria
genostefanov@unwe.bg

Abstract. Technology has already transformed the educational sector, but this change is minimal compared to the sea change that's to come as the IoT reaches critical mass. The goal of this paper is to review and analyze the possibilities for integrating the IoT (IoT) and their impact in educational sector. First the IoT concept is explained and analyzed. Then areas for applying IoT in education are outlined and analyzed. Finally, promising directions for future research are proposed.

Keywords. IoT, Education, RFID, Sensors.

1. Introduction

The term IoT is proposed back in 1999 [1] by British entrepreneur Kevin Ashton, but only in the last 4-5 years it becomes extremely popular. After the computer, Internet, and that of mobile phones, the IoT represents a new technological revolution [2]. It is considered, including the creator of this term that RFID (Radio Frequency Identification) technology is the basis and prerequisite for the emergence and development of the IoT. This is because the technology provides opportunities for remote and automatic identification and data collection via radio frequency communication.

Technology has changed the educational landscape. From the use of tablets in the classroom to the proliferation of open universities, education looks very different today. The IoT—which connects people, processes, devices and data—enhances the volume and value of information we can collect, allowing educators and administrators to turn data into actionable insight like never before. With the advent of mobile technologies, schools can now keep track of important resources, create smarter lesson plans, design safer campuses, and improve access to information and much more. From K-12 up to postgraduate programs, the IoT has the potential to impact every aspect of student learning. As educational organizations begin to leverage solutions like cloud computing and radio frequency identification (RFID) across an IoT platform, they're able to capture, manage and analyze Big Data. This insight provides stakeholders with a real-time view of students, staff and assets. It is this asset intelligence that enables institutions to make more informed decisions in an effort to improve student learning experiences, operational efficiency and campus security [3].

Technology is just one of many disruptive influences in education today. We live in an era where the wealth of data and the exponential growth in the development of new knowledge is challenging institutions to rethink teaching and learning in a global market. There is also a need to prepare students for increasing competition in the workplace. With technology as a catalyst, education is moving from a knowledge-transfer model to a collaborative, active, self-directed, and engaging model that helps students increase their knowledge and develop the skills needed to succeed in the "Learning Society" [4].

IoT will inevitably change the way of teaching and perception of information. The figure bellow illustrates the current state of the education system and its future development with the help of IoT.

There are countless ways to use technology in education, but many are sparse. IoT has the potential to integrate technology with learning in many ways, which are discussed in the next section.

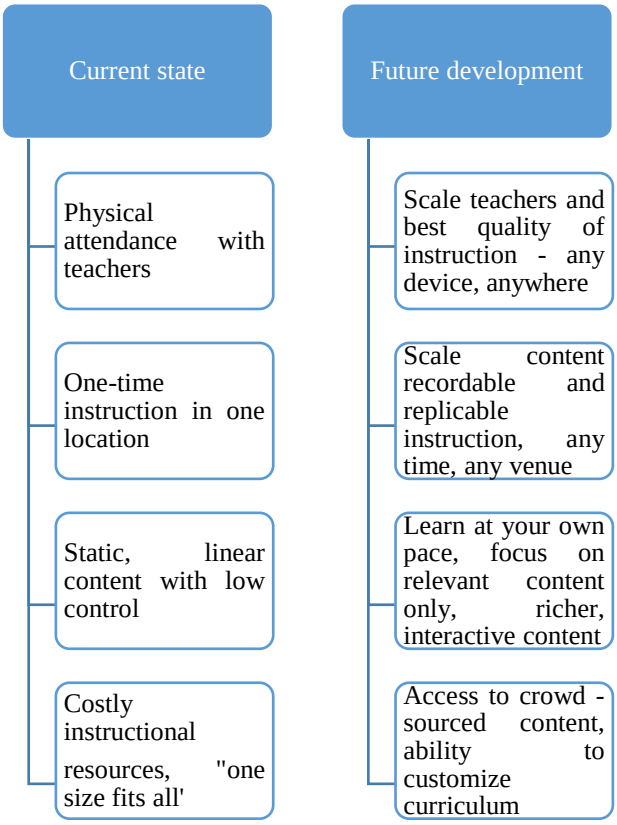

Fig. 1. Current state and future development of education system

2. Applications of IoT in educational processes

IoT in education is in the early stages, but some institutions are leading the way in showing how IoT can be used effectively in educating young people and the public at large. IoT applications have impact in all spheres of education. For a consistent and structured analysis the IoT applications will be divided into 4 groups - people, processes, data and things.

Today, most people connect to the Internet using multiple devices and social networks. It is too soon to predict the channels people will use to connect to the Internet in the future - what is certain is that through such channels, people will be hyper-connected.

The education sector must understand how people connect to the Internet to increase their learning and apply their knowledge as a result. Time to mastery will be key knowledge gained today will be used tomorrow.

The advent of massive open online courses (MOOCs) is another step toward global education. MOOCs are aimed at large-scale interactive participation and open access via the web. Some of the world's leading universities are making their top professors available free of charge, and online forums that are linked to MOOCs will become spaces for new networks to

develop and grow, connecting people from all walks of life and giving education to those who do not have access to high-quality content or instructors in their own locale.

As they evolve, MOOCs will generate large data sets of information on the average size of individual MOOC registrations, the number of dropouts, attendance in online forums per course, the percentage of students who take certification assessments, and more. Such information will give institutions insight into students' locations, their reasons for taking (or not taking) a MOOC, and, if applicable, their reasons for dropping out. This information will help MOOC providers improve the development and marketing of their courses.

IoT can also support professional development for teachers who may adopt new learning models, as data about their practice is collected through student feedback, teacher achievements, and video recordings. This data can be used to examine the teachers' strengths and weaknesses, and form the basis for debate and subsequent adjustments to their pedagogy. Excellence in teaching can then be profiled using the recorded videos, which can be made available to other teachers as a professional development tool used to explain and spread good teaching models.

Process plays an important role in how people, data, and things work together to deliver value in the connected world of IoT. With the correct process, connections become relevant and value is added because the right information is delivered to the right person, at the right time, in an appropriate way. Ensuring that young people have access to learning opportunities that meet their needs will make education more efficient, improve time to mastery, and motivate learners. Such opportunities will also increase student retention and the application of new knowledge, which is vital for future success in both work and society.

Much value can be derived from feedback on a student's performance. For example, a learner studying 10th-grade geography could observe his or her ranking in real time against all learners studying the same level geography. The process could eliminate examinations used to measure and compare learners' performance and achievement. The model of measurement could be accurate at any moment in time, providing ongoing, targeted, and personalized feedback on what a learner must do to improve his or her understanding and performance.

Process is also key in tracking attendance and use of virtual learning environments, purchasing books, collecting data on study habits, and managing physical access to areas on campus. Ultimately, this data can be incorporated into a full-fledged analytics system to customize students' education.

As things connected to the Internet evolve, they will also become more intelligent, thereby providing more useful information. Rather than just report raw data, connected things will soon send higher-level information back to machines, computers, and people for further evaluation and quicker decision making.

The implications of this in education are enormous. For example, as part of their studies, learners could tag physical objects, collect data about those objects, and then feed that information to other programs for analysis, improving the accuracy of their research. Learners could also access data from research initiatives, monitor programs on oceanography or climate change, or watch animals in their natural habitats via live webcams then collect data on their movements through sensors attached to the animals' bodies. The authenticity of such data will have a huge impact on learners' interests. Furthermore, collecting data remotely will also help people reduce their carbon footprints through fewer field trips.

IoT takes data-driven decision making in education one step further, encouraging innovation that motivates and excites learners, turning passive learning into active learning, informing educators about students' lifestyles, and helping teachers develop better curriculum and assessment structures.

Things are physical items that can be connected to both the Internet and people via sensors. Sensors give things a "voice": by capturing data, sensors enable things to become context-aware, providing more experiential information to help people and machines make relevant and valuable decisions.

For example, smart sensors are being used today in bridges to monitor temperature, structural integrity, and traffic density in real time. In this way, students can learn physics using their portable devices to collect and observe the bridge at peak traffic times. Capabilities like these have huge implications for learning and the potential to help transform pedagogical practices.

Special education is another area where sensors can have a huge impact. In Australia, sensor gloves are being explored to provide feedback to children learning Auslan sign language from a computer. A learner attempts to sign while wearing the glove; the information is fed back to the computer, which gives the learner feedback on the accuracy of his/her signing. Researchers believe that a learning system could be developed only if the feedback is timely and accurate for a wide range of learners.

3. Conclusion

This paper presents an overview of the topic of integrating IoT in educational sector. Four groups of possible applications and areas were reviewed and analyzed.

Successful integration of IoT in the educational system will be slow and in many different shades. Some educational institutions can use it to save money or to collect data for further analysis. Some will use it creatively for special educational needs. The aim of IoT to customize curricula and implement interactive technologies will face difficulties related to financing methods and the conservative educational system.

The IoT would allow for better operational efficiency in every type of learning environment. Connected devices could enable educators to perform dynamic classroom interventions. Logging attendance would be simplified if students had a wearable device that tracks ECG patterns. EEG sensors could be used to monitor students' cognitive activities during lessons. Classroom discipline would be much more easily enforced with vibrations that are similar to a silent notification on a mobile phone. These devices could redirect a student's attention, such as giving a warm-up exercise to do on their device.

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Mobile BI Dashboard Design

Veska Mihova

University of National and World Economy, Sofia, Bulgaria
vmihova@unwe.bg

Abstract. The paper reviews common principles and best practices in dashboard design for mobile devices. The challenge of designing a dashboard for mobile devices is providing relevant content in a smaller screen size that is easily processed on a mobile device. Designing mobile BI dashboards is a very complex task. The needs for functionality and mobile user expectations and experience have to be combined. The report analyzes some of the best practices in designing mobile dashboards. Directions for future research are outlined as well.

Keywords. Business Intelligence, dashboards, mobile dashboards.

1. Introduction

Dashboards have become more and more popular over the years due to their ease of use and the information they provide.

Smartphones and tablets are increasingly employed for business purposes and when paired with business intelligence to create mobile BI, workers are able to access information wherever they are, at any time, and through a variety of devices. With business intelligence mobile applications for smartphones and tablets users can interact with reports, analysis, dashboards and more on the mobile device of choice.

This use has the potential to increase employee productivity, enhance customer service and satisfaction, improve decision making and provide a competitive advantage.

The purpose of this report is to review common principles and best practices in dashboard design for mobile devices in order to outline basic qualitative aspects of the most popular ones.

2. Definition of Mobile Business Intelligence

Mobile business intelligence (Mobile BI) is the ability to access BI-related data such as KPIs, business metrics, and dashboards on mobile devices. The concept of mobile BI dates back to the early 1990s when mobile phone use first began to become widespread. Early advocates of mobile BI immediately grasped the potential of mobile phones to simplify the distribution of business-critical data to mobile or remote workers. However, it wasn't until the advent of the smartphone that mobile BI began to generate widespread attention. [1]

Mobile BI is defined as "The capability that enables the mobile workforce to gain business insights through information analysis using applications optimized for mobile devices" [2] Business intelligence (BI) refers to computer-based techniques used in spotting, digging-out, and analyzing business data, such as sales revenue by products and departments or associated costs and incomes.

Although the concept of mobile computing has been prevalent for over a decade, Mobile BI has shown a growth only very recently. This change has been partly encouraged by

a change from the 'wired world' to a wireless world with the advantage of smartphones which has led to a new era of mobile computing, especially in the field of BI.

3. Common principles and best practices in dashboard design

It is important to make sure that some key rules are followed when starting a dashboard project to make it successful.

Business intelligence that leverages traditional BI assets, like dashboards and reports, deliver information in a mobile-friendly way to large audiences through smartphones, tablets, etc. It's often used to enable the remote workforce, so employees are always connected, wherever they are and at any time, and they can derive insights and take immediate action as needed. But designing for mobile isn't just about being responsive – there's more to it. There are some key elements to designing effective dashboard applications [3].

The following are some of the best practices to keep in mind when designing for the user on the go.

a. Simplicity is the Key

Dashboard should be limited from two to five views. Overcrowding the dashboard will make it less usable.

With a smaller screen size than desktop monitors, the number of elements on a given screen should never exceed four to five. To fit any more than that, the size of each element would be too small to be viewed appropriately and it would result in an overly busy visualization. [4]

Simple chart types like line charts, bar charts, area charts, and highlight tables are great for mobile dashboards, particularly when paired with high-level summary stats. Simplified field maps and dot maps are great, too. [5]

b. Intuitive navigation

All navigation should be intuitive enough not to require a training manual. Although forcing users to jump around the screen all the time to view anything should be kept in mind.

Most important views should be put on the top left. This is the point which is where users' eyes naturally start.

Key information, summarized data or key trending have to be positioned on the landing page. Navigation using drill downs or pagination for secondary details should be allowed. If there is still need to display more elements anyway, drill down and drill through should be used as well as pagination using custom "Next", "Back", & "Home" buttons.

c. Be stingy with legends and filters.

Usually not all of the filters are necessary, so elimination of unnecessary filters have to be considered. Use real estate cleverly – If the dashboard needs more than just few filters/selection items then sliding panel could be used to bring the filters up and slide it back to hide them post-selection. This allows full real estate for displaying the data.

The filters have to be limited to three or four filters for each screen. Any more filters will cause the windows to scrunch, making it harder for the user to interact with the filters. The filters have to be optimized for single-select slider filters which are easier to interact with on the phone, should be considered. The fields could be turned in a dimension into buttons, or a simple field map, bar chart, treemap, or highlight table could be used as touchable filters for another view.

Another trick to simplify the views and save space is to create filters with parameters. Instead of using one measure at a time for a series of similar charts, chart with user parameters could be made. By this way, the users can choose which measures they want to use for that chart.

d. Keep tooltips minimal and focus on the data in the dashboard

There is something we wouldn't say about dashboards for the desktop or the tablet: Keeping tooltips simple. The text under three lines could be kept. Turning off the command options helps keeping the tooltips area small and concise. The designers could also use simple labels as a stand-in for tooltips. This will allow users to read the charts more easily without having to relying on tooltips on a small screen.

Developing a great-looking dashboard that doesn't have the data which the business is looking for is worthless. IT's prototype with the vendor demo might have looked great, but the excitement wears off when there's no substance behind it. While the dashboard is being developed, the designer has to be sure that someone is focused on getting data to populate it.

e. Optimize for touch screen

The situation that attempt to click or select one area on a page but accidentally select another can be frustrating and time consuming. Users that are analyzing their dashboard don't want to have these pain-points.

An effective advice for touch optimization is - bigger is better. The dashboard designers could use large marks so they are easily selected by users' fingers. Designers also could use large font sizes so that text can be easily read.

The mobile dashboard designers could include spacing between filters, links, and visuals for greater clarity. Mobile devices are smaller and can be challenging for users to make selections of objects are too close to each other. Providing enough space between each objects will make the user experience quick and more importantly!

f. Use Colors Wisely

The more colors have in a report or dashboard, the harder it gets to discern the key findings. Often times, it's easier to pick out important values from a simple data than on a nice chart with too many colors and data points. Ideally, the designer wants to include fewer and distinct colors that can tell your story effectively without distracting the user.

One tip to create the most aesthetically pleasing mobile applications is to contrast the background and foreground colors. It should be noticed that mobile devices tend to have darker backgrounds and lighter colors to represent the objects in the foreground. KPI's and outliers tend to stand out much easier and allow users to get the answers they need at a quick glance.

Another tip for using color wisely is providing an intuitive workflow for users, this will eliminate confusion and accelerate the learning curve. Keeping the same colors across all reports will help to tell the story effectively.

When there is a report to drill down to a detailed report, a completely different layout and styling could be an issue. It's vital to be consistent throughout the entire mobile asset. [6]

4. Conclusion

The most important thing to keep in mind is that mobile BI dashboards are still a young concept and area to explore. For these reasons this area is an interesting area for future research.

However, if the business and IT work together aiming towards an end result that uses mobile design best practices, proper planning and scoping, it will only benefit the business at the end.

Using dashboards is the most effective method of presenting information to the business to enable performance management and foster effective analytics.

Incorporating these common principles and best practices, reviewed in this report, will help to build effective dashboards for an organization.

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Using Web Automation for Integration Purposes in Business Process Management Projects

Ivan Belev

University of National and World Economy, Sofia, Bulgaria
i.belev@unwe.bg

Abstract. The paper explores the options to use web automation techniques as an integration method when implementing a Business Process Management system in an organization. It builds on a series of previous papers from the author. An overview of the integration method is described as well as a list of needed web automation features to support the creation of complex integration rules.

Keywords. Web automation, Integration, Business Process Management.

1. Introduction

The rapid development of computer software for business management purposes throughout the years has led to the creation of different software categories such as Enterprise Resource Planning (ERP), Business Intelligence (BI), Data Mining, Enterprise Content Management (ECM) and many more. The dynamic environment in which business companies operate forces them to change their business processes more frequently and in a very short time in order to be competitive and successful. This leads to the evolution of standard Workflow Management Systems (WfMS) into what we call today Intelligent Business Process Management Systems (iBPMS). What is different for this type of software systems is that such a system completely takes over all process management functions from other management software systems (such as ERPs, etc.) pushing them in the background. In order to implement such a system a company needs to integrate it with all other management software systems so that all systems can communicate and share data.

The purpose of this report is to explore the possibility to use a specific technique – web automation as an integration method when implementing a Business Process Management system in the company and connecting it to other software systems. In order to be more clear it is mandatory to define the main terms first:

Keith Swenson and Mark von Rosing [1] give a vary complete definition of Business Process Management (BPM): *Business process management (BPM) is a discipline involving any combination of modeling, automation, execution, control, measurement, and optimization of business activity flows in applicable combination to support enterprise goals, spanning organizational and system boundaries, and involving employees, customers, and partners within and beyond the enterprise boundaries.*

The next important term is systems integration. From the BPM point of view systems integration is bringing together all the necessary software systems and/or data in an organization so that a complete environment can be created for the implementation of Business Process Management system. The implementation of BPM system doesn't remove the other software systems in the organization – it only organizes the process workflow and process management tasks. Therefore, the BPM system cannot function on its own, without the other systems in the organization.

2. Previous research

The author has explored a few other topics in his previous research that led to the development of the current study.

First, an exploration of the integration methods for Business Process Management platforms was conducted. The most common integration methods were outlined and briefly described.

Based on the results the author defined a list of conditions that an organization should comply with in order to be able to implement a BPM software system and connect it to its other systems and data.

Next the author described the most common integration problems that organizations face during a BPM software implementation project.

After that the author created a list of questions on the BPM topic and conducted a survey in all accredited Universities in Bulgaria. The focus was set on the Universities in Bulgaria as a potential user of a Business Process Management system. The questions were sent by email to the people responsible for the IT infrastructure in the University. About twenty Universities responded to the survey. Some of the most important conclusions are:

- 86 % state that a Business Process Management system is necessary in the University;
- Only 20 % of the Universities already have a BPM system implemented;
- 10 to 47 % of the Universities don't comply with different integration conditions for implementing a Business Process Management system;
- 100 % of the Universities have web applications in their software environment;

Finally, the author decided to search for a solution – a new integration method that would make possible the integration of BPM system with existing web applications when the organization cannot fulfil the integration conditions. Web applications were chosen because of the trending web technology and the wide use of web applications in all types of organizations, including Universities. To further clarify the terms, a web application can be defined as any computer application that is executed in a web browser.

3. Web automation integration method overview

Web automation is most commonly defined as techniques for automating tasks in a web application or environment that are normally performed by a human. The most general use of such technology is for application testing – to save time and effort when carrying out the same tasks numerous times. Practically web automation instructs the browser to automatically perform operations, such as mouse moves and clicks, keyboard typing, text select and other operations. These operations are done automatically, very quickly and may be done as a background process, invisible to users.

In previous research the author identified the most common integration methods that are used to connect a Business Process Management system with existing web applications:

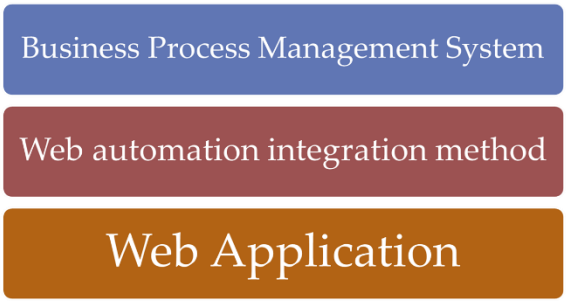
- Using web services (the Service oriented architecture approach);
- Relational database integration – either using SQL queries or SQL stored procedures;
- Using Application programming interface (API);

Based on all previously said the new integration method should have the following characteristics:

- the method uses web automation techniques;
- the method carries out the data exchange between the Business Process Management system and a web application;
- the method doesn't use any of the common integration scenarios;

In order to achieve the desired level of integration two important points need to be made:

First, the method should act as a mediator between the BPM system and the target web application. Because web automation is used to carry out the exchange of data, the BPM system should always be the initiator of all requests for data exchange.



Second, the web automation integration method should provide the ability to read data from a web application and also to input data. The operations should be carried out in the background.

A simple definition for the execution steps of the method can be made:

- The Business Process Management system issues a request for data exchange (either to gather some data from the application or to input some data);
- The integration method uses web automation to open the web application in the background, perform a number of steps to gather and/or input the required data and return a response to the BPM system;

4. Web automation integration method features

The web automation integration method should provide numerous features to be able to carry out complex integration tasks. Each complex task can be broken down to a series of simple tasks or actions. Defining the required simple actions will also define the list of required features:

- Open page – the method should be able to navigate to a web application page by a provided URL address;
- Locate web elements – the method should be able to search a web page and find a specific web element on the page. There are multiple ways to locate a web element on a web page, depending on the element type and other conditions:
  - By id of the element;
  - By element class name (class name refers to the HTML Document object model attribute);
  - By element tag name (tag name refers to the HTML Document object model tag name);
  - By element name (name refers to the HTML name attribute);
  - By link text (available if the element is a HTML link);
  - By partial link text (available if the element is a HTML link);
  - By CSS (using the Cascading Style Sheet selectors) – here there is a list of available CSS selectors such as class, id, element type, attribute value, etc.;
  - By XPath (using an XPath expression to locate a web element);

- Get text value – the method should be able to get the HTML innerText value in a page element;
- Input values in a field – the method should be able to fill in values in an input field of different data types;
- Select values in filed – the method should be able to handle SELECT fields such as dropdown fields, checkboxes, radio buttons, etc.
- Click a button – the method should be able to click buttons on pages;
- Move between windows and frames – sometimes a web application will open different windows or a page will contain different frames. The method should be able to switch between different windows and frames;
- Handle popup dialogs – some actions in a web application will open up different type of popup dialogs - alert, prompt, confirm, etc. The method should be able to switch to the popup dialog and accept, dismiss or type into the prompt;
- Handle page navigation – the method should be able to move backwards or forwards in the browser history;
- Handle browser cookies – some web applications require the use of browser cookies. The method should be able to create, get or delete cookies;
- Wait – the method should be able to wait for an operation to complete before executing the next one. In most cases this is done automatically, but sometimes this has to be done explicitly (for example, some actions in a web application will trigger asynchronous calls and update only a part of the web page. In this case automating a click on the page should be followed by an explicit wait before the next operation – getting the results from the page).

Some more advanced web applications may require additional features in order to complete the automation of the human activities, for example – drag and drop functionality, setting browser proxy, allowing restricted actions or browser plugins or other advanced features. For most cases however, the listed simple featured should be sufficient in order to achieve the data exchange operations. Every request for data exchange by the Business Process Management system can be broken down to multiple simple operations using any combination of the listed features. An example simple request for some data in a web application can be achieved by automatically executing the following series of simple actions:

- opening the application page;
- locating a field on the page;
- typing input data;
- Pressing the search button;
- Selecting the text result;

Every simple action of the web automation integration method may or may not require one or more parameters for its execution. For example:

- The Open page action should require a URL parameter to specify which web address to open;
- The Input value action should require two parameters – one to find the specific input field on the page and one, containing the input data to pass to the field;
- The Page navigation back action shouldn’t require any parameters;

5. Conclusion

The implementation of a Business Process Management system is a complex task, that includes integrating the BPM system with other software systems in the company. This integration is required in order to achieve optimized business processes and eliminate the need

for an employee to carry out many actions in multiple systems. Setting the focus on the University as an organization that would benefit from managing its processes better, sometimes the common system integration conditions cannot be fulfilled.

Defining a new integration method based on web automation techniques can achieve the required level of integration between a BPM system and web applications in the organization when all other integration options are not available. Complex integration tasks can be performed by executing a series of simple web automation actions.

The results of the studies so far give the author the opportunity to further research and develop the web automation integration method.

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Relational Database Model for Defining Web Automation Integration Rules

Ivan Belev

University of National and World Economy, Sofia, Bulgaria
i.belev@unwe.bg

Abstract. The paper extends previous papers from the author that explore the need and the possibility to use web automation techniques for integration purposes. A sample web automation integration rule is presented. In addition, the author proposes a relational database model that will hold all necessary data for defining and executing complex web automation rules.

Keywords. Web automation, Rules, Relational database, Model.

1. Introduction

The purpose of this paper is to extend the author's studies in the field of Business Process Management (BPM) software and its integration into the IT environment of the organizations. The author has proposed a new integration method that uses web automation techniques to achieve the data exchange between the BPM system and a web application. As in previous papers, the author starts the introduction by giving a brief definition of the main topics that are discussed.

The main area of research is Business Process Management (BPM). The authors of The Complete Business Process Handbook [1] analyze numerous sources trying to draw a precise definition of BPM. They propose a definition of Business Process Management that includes the following key points:

- BPM is a discipline, not just software, theory or methodology;
- BPM can include modeling, automation, execution, control, measurement, optimization of business activity flows (process steps);
- The purpose of BPM is to support enterprise goals;
- BPM spans beyond organizational and system boundaries and therefore it involves employees, customers, partners, and other related parties.

The research is not only focused on BPM, but on the integration aspects of this technology. Therefore, the term systems integration is very important. When implementing a Business Process Management system, the organization has to bring together all the necessary software systems and/or data so that a complete environment can be created. All related systems and data should work as one with the newly implemented BPM software.

Another key topic in this study is web automation. The discussed integration method uses web automation techniques to achieve integration tasks. Web automation (or sometimes referred to as web test automation) is commonly used for testing web applications. It empowers the computer system to automate steps that are executed in a web browser and are normally performed manually by the user.

2. Previous research

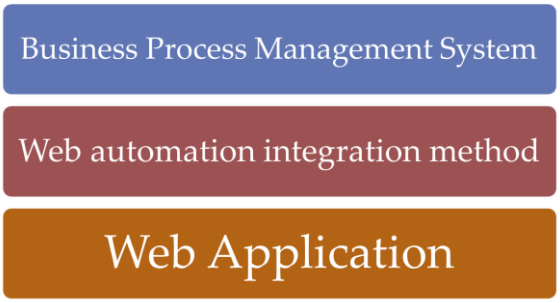
This paper extends the following topics from previous research of the author:

- A study that explores the usability and benefits of Business Process Management technology in Universities;
- A study that examines the most common integration methods that are used when a Business Process Management platform is implemented in the IT environment of a company;
- A paper that aims to highlight conditions for implementing a BPM system and integrating it with existing applications and data;
- A study of the most common integration problems that may occur when implementing such a system;
- A private survey on the Business Process Management thematic among accredited Universities in Bulgaria;
- A paper that explores the possibility to use a new integration method that would help implement a Business Process Management system. The method is called Web automation integration method because it uses web test automation techniques to make possible the data exchange with an existing web system when the common integration methods are not possible;

The conducted research by the author led to the conclusion that the proposed method is promising and should be further developed.

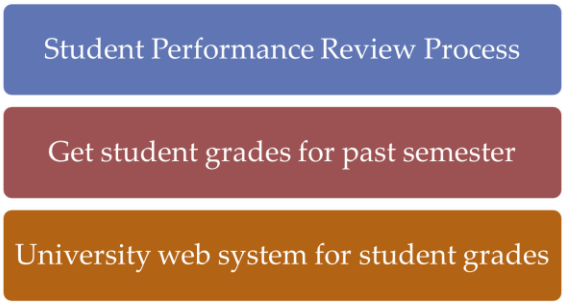
3. Web automation integration example

The web automation integration method should act as a mediator between a Business Process Management system and a given web application in the organization. In theory an overview schema would look like this:



To make this more understandable for the audience the author proposes an example:

A University implements a BPM system in order to start managing and optimizing its processes and reduce the number of software applications that employees need to use every day. A new process is developed that requires an employee to review the performance (grades) of students – Student performance review process. This has been done previously by accessing an in-house university web application for student grades. The optimization requires this review to be done in the new process without having to open other applications. Normally this would be achieved by integrating the BPM system with the student grades application by using one of the common integration scenarios – using web services, using database integration (either direct SQL queries or using stored procedures), using an Application Programming Interface (API) or using data exchange with structured files export (XML, CSV, etc.). For this example case none of the common integration methods are possible. The above schema for this example would look like this:



Using the web automation integration method, the described scenario can be achieved by instructing the system to conduct a series of steps as if it was the user. The method should open the student grades application (all work is done in the background not visible by the user) and perform a login and a search for student grades based on defined input parameters. After that it shall return the results to the BPM system and they can be displayed in the process task.

In a previous paper the author described the overview of the integration method and it's features. The web automation method conducts complex integration tasks (such as the described example above) by breaking them down to simple web automation actions (rules). The actions include:

- Open web page;
- Locate web elements on a page by different identifiers (id, class name, tag name, CSS, XPath, etc.);
- Get text value from a page element;
- Input values in a page field;
- Select values in page select field;
- Click a button on a page;
- Move between windows and frames;
- Handle popup dialogs;
- Handle page navigation;
- Handle browser cookies;
- Wait;

The example integration operation – Get student grades, can be described as follows.

The operation will use the following input parameters:
- Web application URL;
- Id of login username input field web element;
- Login username;
- Id of login password input field web element;
- Login password;
- Id of login button;
- Id of student search field web element;
- Student unique id;
- Id of search submit button;
- Number of milliseconds to wait for search results;
- Id of search results web element;

The integration operation will have the following sub actions (Rules):
- Rule 1: Open web page (parameter: web application URL);
- Rule 2: Input username field (parameters: id of username input field; username);

- Rule 3: Input password field (parameters: id of password input field; password);
- Rule 4: Click login button (parameter: id of login button);
- Rule 5: Input search field text (parameters: id of search field; student unique id);
- Rule 6: Click search button (parameter: id of search button);
- Rule 7: Wait for results (parameter: number of milliseconds);
- Rule 8: Get search results (parameter: id of search results web element);

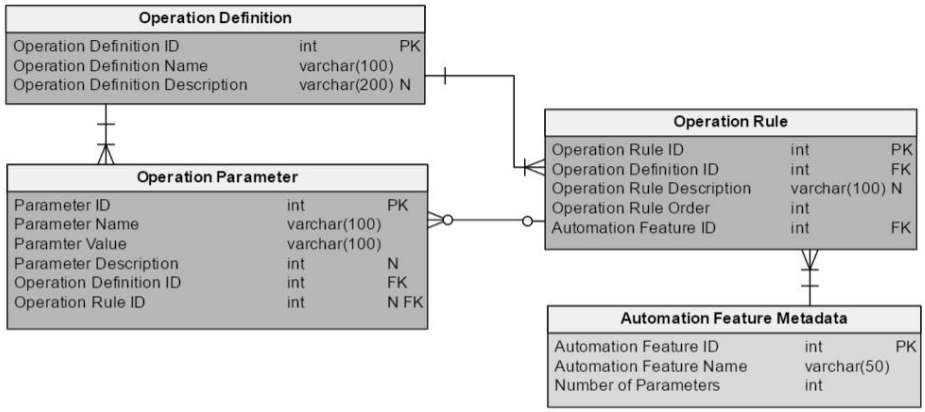
The web automation integration method is called by the Business Process Management system with the appropriate input parameters. The actions are performed by an execution engine and the results are returned to the business process. To complete the implementation of the method an appropriate database is required that would hold the data for the operations, actions (rules), parameters and metadata.

4. Web automation operation database model

The implementation of the web automation integration method requires a database structure to aid the following important tasks:

- Defining new integration operations and rules (actions);
- Executing previously defined operations;
- Managing metadata for the available web automation features (actions);

The author proposes the following relational database model:



The model consists of three tables to hold data for operation definitions and one table for automation features (actions) metadata. The table and field names are given in a readable format that includes spaces only for the sake of presentation. For actual implementation of the database model the table and field names should be changed to comply with naming rules and best practices.

The Operation Definition table holds the master data for every defined operation – an auto generated id, a name and a description.

The Operation Parameter table holds the detail data for input parameters for every defined operation: an auto generated id, parameter display name, parameter value, parameter description and reference keys to the other tables.

The Operation Rule table holds the data for every sub action (rule) that an operation must carry out to achieve the required overall result. The table has columns for auto generated id, rule description, rule execution order and reference keys for the operation master table and

the metadata table. The defined parameters for the operation (in Operation Parameter table) are also linked to the specific rules via a reference link.

The Automation Feature Metadata table contains metadata that corresponds to the available automation features, defined in the operation execution engine. The data includes an auto generated id, feature name and required number of parameters for the feature. When the execution engine receives an instruction to perform a web automation operation, the specific actions are executed based on the Automation Feature ID. For each operation, the rules are executed in the Operation Rule Order. The engine passes the defined parameters for each rule and thus achieves the completion of the integration operation.

5. Conclusion

The conducted study on the topic of this paper brings the author closer to developing a complete integration method that would make possible the integration between Business Process Management systems and web applications when common integration scenarios are unavailable. The proposed example for simple university process and the necessary integration operation aim to describe the author's concept and make it more understandable for the audience.

The author also defines a preliminary relational database model to aid operation definition, operation execution and to hold automation features metadata. The author continues his research, seeking to create a complete method specification and a working prototype that would actually make possible the implementation of Business Process Management systems in organizations that are facing integration problems.

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Applicability of Business Information Systems Integration Approaches from Technical and Management Perspective

Smilen Kouzmanov, Monika Tzaneva

University of National and World Economy, Sofia, Bulgaria
skouzmanov@gmail.com, mtzaneva@unwe.bg

Abstract. Business software integration approaches and techniques applicability in practical integration projects and scenarios depends on both operational/technical and management/business aspects. This paper proposes some generalized conclusions about applicability of different types of integration approaches according to the technical and business context. If these conclusions are taken into account, they can be used to choose the right integration approach from business and technical point of view.

Keywords. Business software, Integration, Technical and Business Context. Integration approaches and techniques.

1. Introduction

We have researched and classified major integration approaches like point-to-point integration, data-level integration, inter-process communication with distributed objects, integration based on central-mediators (message brokers or busses) and service-oriented integration (Kouzmanov, 2015). We have evaluated and compared them according to predefined sets of technical and business criteria (Kouzmanov, et al., 2015), which are covering the major aspects of practical integration solutions and projects. Based on this comparison, we can choose such a subset of known and adopted integration techniques, which will deliver easier applicability, performance and successful results according to the project. In the following sections we will consider the most applicable integration approaches according to the technical and business aspects.

2. Applicability of Integration Approaches from Technical Aspect

According to the technical criteria, we can state that when it comes to coupling, scalability, extensibility and transparency, point-to-point integration is characterized with a low applicability rate. Similar, relatively low applicability according to coupling, scalability and transparency is also typical for approaches like data-level integration and inter-process integration with distributed objects. Transparency is the only criterion from this group in which the latter approaches have better performance.

On the other hand, we have to note that integration approaches based on central mediation components and service-oriented integration are usually delivering low coupling between systems, which is often a preferred scenario. They are also delivering high applicability according to criteria like scalability, extensibility and transparency.

According to message passing and abstraction level, we can state that point-to-point integration, data-level integration and inter-process communication with distributed objects are characterized with low applicability rates. Point-to-point integration is the only one that has slight advantage according to the message passing criteria, but we have to note that this

type of integration approaches is adopted mainly for synchronous message passing (Nghiem, 2002).

We may point that integration approaches based on central mediation and service-oriented integration have better applicability rates according to the message passing and abstraction level criteria also. When it comes to software services, we should note that their advantage in the abstraction level perspective is highly dependent on their modularity, granularity and ability to split complex problems into simple tasks (Schulte, 2002). The flexibility of the approach in complex and heterogeneous integration environments is also very important in this field (Arsanjani, 2005). Despite the higher level of abstraction, service-oriented integration approaches are more applicable in real-time message passing integration scenarios. On the other case, when a batch processing is needed, approaches with related to direct data transfer are better adopted, because of their simplified architecture and straight-forward implementation.

Last, but not least, we have to state that according to exception handling and source code specifics and characteristics, point-to-point integration, data-level integration and inter-process communication with distributed objects will deliver lower and unsatisfactory levels of applicability rate.

On the other hand, integration approaches based on central mediation components and service-oriented integration approaches are having a very high level of success and applicability rates according to the latter criteria.

3. Applicability of Integration Approaches from Management Aspect

In terms of management type criteria, it should be noted that both point to point integration and the data-level integration has rather high implementation cost/effort and total cost of ownership/operation. The main reason is the difficult, effort-consuming and expensive addition of new systems to the environment. We should however note, that the data-level integration and shared repositories based approaches will deliver some reduction of the cost compared to classical integration (O'Brien, 2008).

On the other hand, we should note that inter-process communication with distributed objects, integration based on central mediation components and integration through software services usually has lower level of implementation costs and total cost of ownership/operation, so according the criteria set they are much more applicable too.

According to the project success rate, we should note that point-to-point connection and data-level integration are usually characterized with a relatively low success rate in real projects, because of their technical disadvantages, while integration based on central mediation components and integration through software services usually have high success rate. Inter-process communication with distributed objects falls between the two groups above, with a mid-class success rate.

4. Applicability of Integration Approaches from Business Aspect

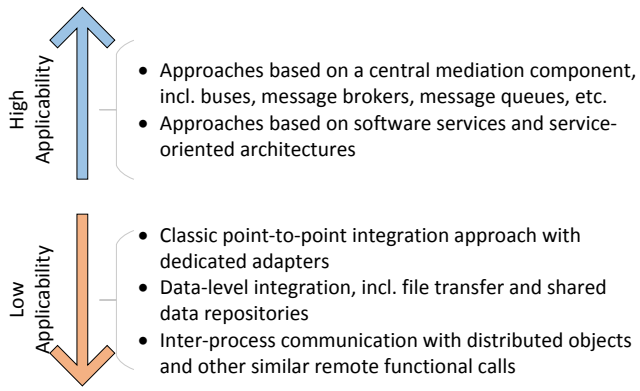
From business and organizational point of view, we may point that point-to-point integration approaches has the most negative perception from business and consumers. Data-level integration, inter-process communication with distributed objects and integration based on central mediation components usually has moderate or moderately positive perception from the same auditory.

On the other hand, service-oriented integration is characterized with the most positive user perception, mainly because of its high user transparency levels, so according to this criterion this approach has the highest applicability rate.

According to the service level agreements (SLAs), lower applicability rates are a characteristic again of the point-to-point connection and data-level integration, since this approaches have no formalized instrumentation to define an SLA. Inter-process communication with distributed objects has a moderate applicability according to this approach, while a good, very high applicability according to the SLAs is delivered by the integration approaches based on central mediation components and service-oriented integration.

5. Conclusion

Based on these summarizations, we can conclude that integration approaches based on central mediation components and service-oriented integration are the only two types of integration approaches which are distinguished with high applicability rates according to all aspects and criteria taken into consideration. We can also conclude, that the combination of them will be a good choice for a wide range of practical projects and will deliver a high success rate.



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Forecasting Bulgarian Unemployment Rates Using STL in R Software

Alexander Naidenov

University of National and World Economy, Sofia, Bulgaria
anaydenov@unwe.bg

Abstract. The paper presents the results from the experimental estimation and forecasting of the Bulgarian unemployment rates based on the seasonal and trend decomposition using the locally weighted scatterplot smoothing regression (STL). The reasons for the usage of local subsets of values for the curve fitting instead of a general time series model are discussed and a comparison between models is provided.

Keywords. Unemployment rates, time series, STL, LOESS, local regression.

1. Introduction

When there is a need for a time series analysis of some economic data (e.g. unemployment rates), especially for the purpose of forecasting, statisticians usually try to find the best model in order to predict the future in the best possible way. Because of the non-linear nature of the economic phenomena in the most of the cases the estimated model is too complex and even though it does not fully represent the data analyzed. But what if we change the point of view and estimate the regression curve by fitting a function of the independent variable(s) *locally* and in a moving fashion i.e. in the moving average 'style' [1]. Although the idea about local fitting is not a new one, the discussion has been started by Woolhouse at the end of the 19th century [6], Cleveland [1] made some very important extensions to the existing theory which concern the weighting of the cases neighboring given estimated value in the local fitting procedure [5]. Also Cleveland [4] suggests a thoroughgoing time series analysis including not only the locally weighted scatter-plot smoother procedure (LOESS) but also the seasonal and trend decomposition (STL) for even better forecasting estimations. In the next paragraphs we explain the theory behind the STL methodology and we apply the latter to forecast one of the key macroeconomic indicators - the unemployment rate, using the number of employed and unemployed persons as input data. In order to prove the efficiency of the methodology considered, comparisons of the results from STL and some other 'famous' approaches, concerning the global type fitting methods, are provided.

2. Theoretical background

According to the Taylor's theorem [7] any continuous function can be approximated with low-ordered polynomials i.e. instead of using one globally fitted model (using all data from given time series) we can use series of locally fitted functions (using only a portion of the data) or so called *local regressions*. The latter are part of the parametric localization methods and they are distinguishable from other similarly 'looking' methods such as smoothing splines, wavelets and etc. [6] The LOESS type of local regression fitting is convenient in those cases where the data in a given moment of time are dependent on the data from the neighboring time moments (points in time) so it is reasonable to give bigger weights

to the closer time points to a given time point and smaller weights to the further ones.

The STL approach takes the time series analysis even on a higher level by incorporating the seasonal decomposition [12]. This is a very important issue especially in the case when we analyze macroeconomic phenomena such as employment and unemployment which have pronounced seasonal features.

In order to enlighten the STL procedure the major application steps are presented as follows [4]:

- STL as a filtering procedure decomposes given time series in 3 main components:

$$Y_t = T_t + S_t + R_t \quad (1)$$

Where: Y_t are given data for phenomenon Y at time point t (t=1,2,..,N), N – number of data points (dates, months, quarters, years, etc.), T denotes the trend, S is the seasonal component and R is the remainder (error or irregular term) which incorporates the data at this time point.

Usually in the statistical literature the phenomenon Y is defined as follows:

$$Y_t = f(x_t) + \varepsilon_t \quad (2)$$

Where: $f()$ is a function that specifies the impact of the independent variable x (or more than one) and the ε_t is the error term which includes all random errors or variability from sources not included in the measurement of x_t.

- In order to estimate the trend (T), LOESS methodology is applied as follows [3]:
  - *Smoothing parameter* q ($q \leq N$) is chosen in order to define the local 'area' size for smoothing (how many neighbors are needed to run the local regression). Usually it is defined either as an integer number or as a fraction. In the practice it is advisable to use fraction between 0,25 and 0,50 [10] (In many cases q equals 0,33). If q is large there will be too much smoothing in the trend but if q is too small – more random fluctuations will be caught by the estimated line.

  - *Neighboring weight definition*. Cleveland suggests [2] the tricubic function to be used:

$$w_t = \begin{cases} (1 - u_t^3)^3 & for\ |u_t| < 1 \\ 0 & for\ |u_t| \geq 1 \end{cases} \quad (3)$$

Where w_t is the *weight* for given time point t and u_t is the scaled distance from given time point to its neighbor given as follows:

$$u_t = \frac{|x_t - x_0|}{\lambda_{max}} \quad (4)$$

Where x_0 is the value of the independent variable at a given data point which is the subject of interest, x_t is the value of the independent variable (a time series) neighbor and λ_{max} is the *maximum distance* between the farther neighbor x_t and x_0. The size of the 'neighborhood' is defined by the parameter q i.e. $[x_0 - q; x_0 + q]$.

By the use of the tricubic function bigger weights are given to closer neighbors (on which usually data in given time point depend) and smaller weights are given to the distant neighbors.

  - Using the data for each time point and its neighbors, a *regression analysis* is run. But before running it the type of the function should be chosen – linear, quadratic, cubic or a polynomic from a higher order. Usually researchers prefer simpler function forms such as

the first two mentioned. Because of the weighting procedure usage, in order to estimate the regression coefficients, the weighted least squares (WLS) is applied.

The 'natural' presence of *outliers* in the time series usually defines the need for the usage of so called robust regression [8]. In this case the weights for the WLS procedure are obtained by the multiplication of the neighboring weights and robust weights.

- The time series are *de-trended and seasonal means are applied* in order to extract the seasonal component in the time series.

Because the STL is a recursive procedure there a several passes in the so called inner loop and some in the outer loop [4]. In each of the passes through the inner loop the seasonal and the trend components are updated once. Each pass of the outer loop includes inner loop followed by a computation of the robust weights in order to be used in the next inner loop for the abnormal trend and seasonal behavior reduction.

Concerning the *unemployment rate (UR) estimation* at given time point *t* we have to mention that it is calculated as a derivative of the number employed and the number of unemployed as it is stated in the economic theory [11]:

$$UR_t = \frac{UN_t}{UN_t + EM_t} \tag{5}$$

Where UN_t is the number of unemployed persons at time point *t* and EM_t is the number of employed persons at the same time point.

Therefore, in order to estimate the unemployment rate for Bulgaria, the STL analysis is applied *separately* for the number of employed and the number of unemployed and then the results are *combined* to calculate the rate.

3. Experimental results

The importance of the provision of the 'correct' forecast for the key macroeconomic indicators such as the unemployment rate is straightforward. In order to obtain such a 'good guess' we need to provide a very accurate tool to measure the historical changes in the studied phenomenon. In this case 'traditional' statistical globally targeted techniques fail to succeed. That is why a more detailed method is needed and as it was mentioned above the locally weighted polynomial regression is a good proposition for this purposes. In addition to the locally 'focused' approach, the STL methodology provides better estimates by the usage of the time series decomposition and robust weighting.

For the purposes of the STL methodology application on the estimation of the Bulgarian unemployment rates, the open source *software R* is used. This is provoked not only by the powerful features it provides but also because of the lack of possibilities for forecasting using LOESS methodology in other software products such as SPSS, STATA, etc., which usually provide only graphical representation of the estimated results but not the estimated values.

All the calculations and estimations that follow are based on the data for the number of employed and number of unemployed persons in Bulgaria for the *period Q1 2003 – Q1 2016* (53 time points) which are available for download at the website of the National Statistical Institute of Bulgaria (www.nsi.bg). At the time of the writing of this paper the data for Q1 2016 are the latest available.

The input data used for the analysis can be presented as follows:

UNEMPLOYED:

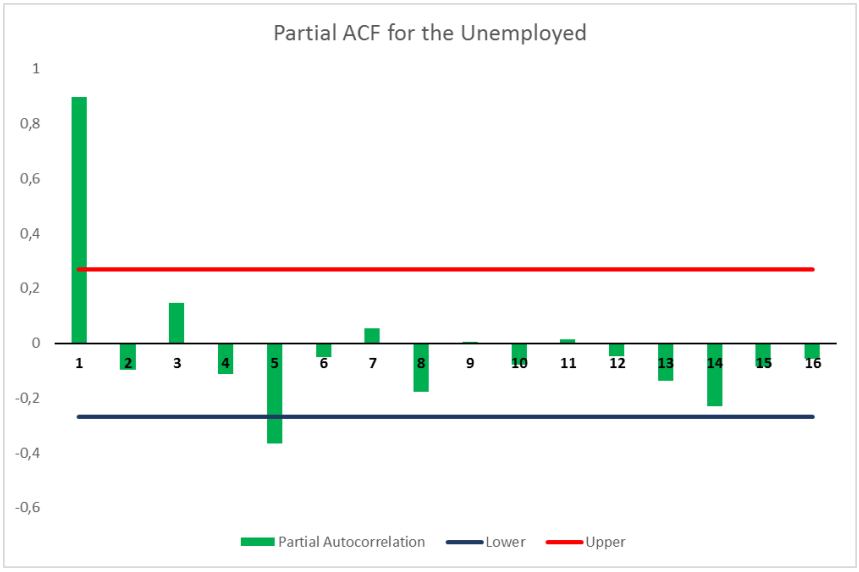
EMPLOYED:

Fig.1. Number of unemployed and number of employed persons in Bulgaria for the period Q1 2013 – Q1 2016

In order to use the time series data in the R software the data are transformed in .dat file format and dated as quarterly ones.

Before the STL methodology application it is needed to check if there is seasonality in the time series (which is obvious from Fig. 1, but not statistically tested) that are going to analyzed. For this purposes the partial autocorrelation functions (PACF) are used. As it can be seen in Fig.2, there are seasonal patterns (values outside lower and upper boundaries) in the data and that should to be considered in following the time series decomposition and forecasting.

UNEMPLOYED:



EMPLOYED:

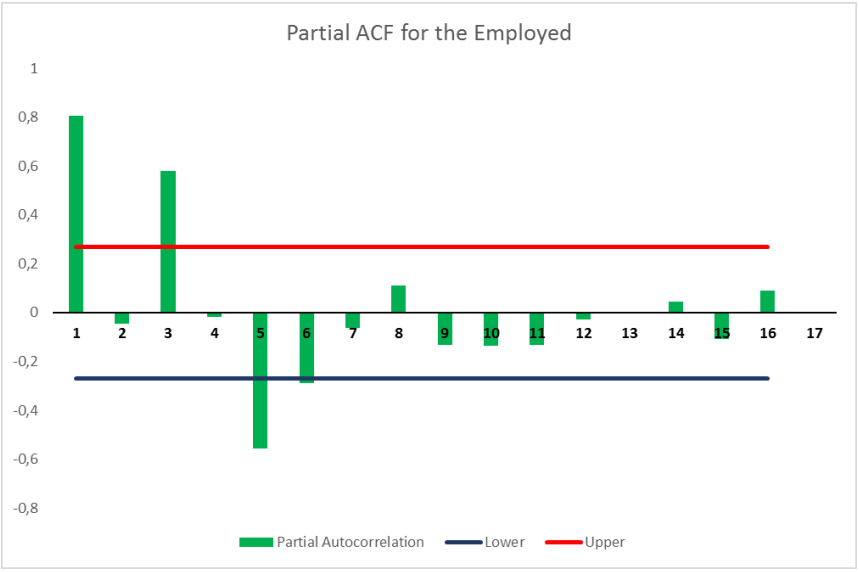


Fig.2. Partial ACF for the unemployed and employed persons

Following the steps described in the section "Theoretical background", the STL methods application requires the procedure parameters definition first. The latter are defined as follows:

- Data are "periodic": *quarterly* based;
- The span (in lags) of the LOESS window for trend extraction (neighboring size smoothing parameter): *q=0,33* (as a typical value)*;*

- Type of the weighing of the neighbors: *tricubic*;
- Type of the polynomial function for the local regression estimation: *linear*;
- Type of regression estimation: *robust* (to reduce outliers influence).

After running the STL procedure in R software [9], using the parameters above, the following results for the trend and seasonal components are obtained:

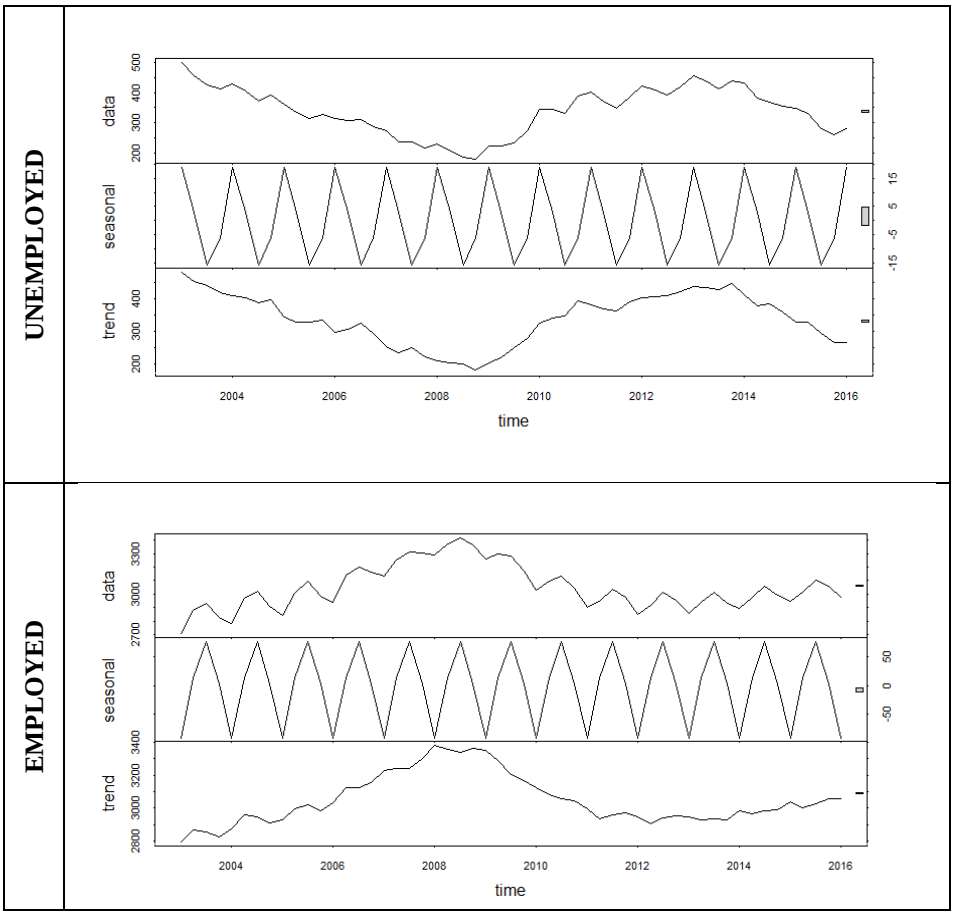


Fig.3. Results from the STL methodology application on unemployed and employed persons' time series (Q1 2003 – Q1 2016)

As it can be clearly seen from Fig.3 there is a seasonal pattern in both time series. Also the trend line is very close to the 'original' (from the graphical point of view). Using the estimated number of unemployed, the number of employed and formula (5), the unemployment rate is calculated. The results are as follows:

Fig.4. Original and estimated unemployment rates using the results from STL procedure

Although the 'picture' shows good approximation of trend to the real data it advisable to check if the STL methodology is 'really' better than e.g. the traditional globally estimated models. For the purposes of the comparison the cubic function and the best ARIMA models for both time series are chosen. The following comparison is based on the mean absolute percentage error (MAPE) which one of the favorite statistic measures of prediction accuracy of forecasting methods.

The analyses are run for both the cubic and ARIMA models and the best ones are chosen. Then the estimates for both time series analyzed are obtained and the results are presented in the following table:

Table.1. Models' comparison based on MAPE

Time series	Model		
	STL	**ARIMA**	**Cubic**
Unemployed	3,4%	5,7%	11,5%
Employed	1,5%	0,8%	2,7%
Unemployment rate	4,3%	5,3%	12,7%

As it can be seen from the table above, the STL method has the smallest mean absolute percentage errors, excluding the time series about the employed persons. Nevertheless, locally weighted polynomial regression using seasonal and trend decomposition (STL) is a better choice than the other globally oriented methods (e.g. cubic function, ARIMA, etc.), because it has the following advantages [6]:

- STL does not require the specification of a function to fit a model to all of the data in time series;
- STL can handle any type of seasonality and the seasonal component is allowed to change over time, also the rate of change can be controlled by the user;

- in STL, the smoothness of the trend can also be controlled by the user;
- STL can be robust to outliers;
- STL results are easy to interpret;
- STL is very flexible and adapts well to bias problems in regions of high curvature;
- STL can be tailored to work for many distributional assumptions;
- STL does not require smoothness.

Using the function *forecast* in R software and based on the results from STL procedure application, we can predict the future fluctuations in the analyzed time series (number of unemployed and number of employed) and therefore we can forecast the unemployment rate as their derivative too. The original unemployment rate, the UR trend, the UR forecast and the 95% prediction interval (Lo and Hi boundaries) are visualized in following figure:

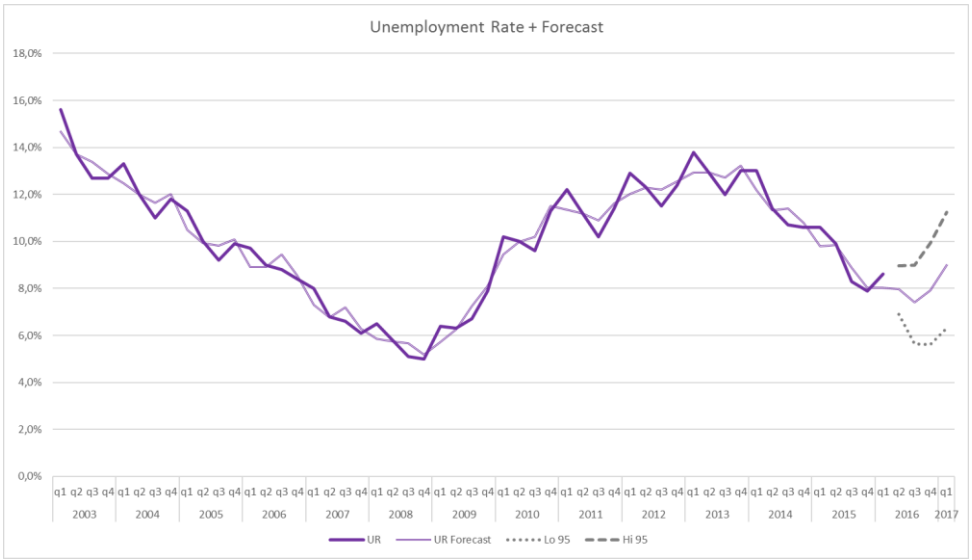


Fig.5. Forecast for the unemployment rate for 4 quarters (Q2 2016 – Q1 2017)

Although STL procedure has lots of advantages, some disadvantages have to be considered too:

- STL requires large densely clustered time series points in order to produce good models;
- STL does not have a regression function form i.e. it is not easily represented by a mathematical formula which means that it is difficult to transfer the results of the analysis to other people in obvious and clear form;
- STL requires good statistical knowledge and programming skills especially in the R language;
- the presence of some extreme outliers can still overcome even robust methods such as STL.

4. Conclusion

The adequate forecast of the unemployment rate, as a key macroeconomic indicator, is of a great importance especially for the government policy. While the globally oriented regression model estimation (e.g. ARIMA models) usually provides a good approximation, in

the modern times we have more powerful tools such as locally fitted regressions on segments of the time series data (LOESS). In addition to the series of local regression estimation application there are some upgrades, such as STL method, which provides even better basis for 'almost perfect' fitting and forecasting, taking into account the seasonality in the economic time series. As it was stated above seasonal and trend decomposition using the locally weighted scatterplot smoothing regression provides enough evidence to consider that complex economic phenomenon should be examined in more 'detailed' manner to deeper the understanding for it. However, the STL methodology is not a 'panacea' to all time series analysis issues and should be applied carefully, considering its limitations and the specific particularity of a given study.

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A Quasi-Experimental Approach to Assessing Net Effect in Active Labour Market Policy in Bulgaria

Atanas Atanassov

University of National and World Economy, Sofia, Bulgaria
atanassov@econometrica.bg

Abstract. The paper reviews various methods that can be used to evaluate the net effect from the active programs and measures on the labour market. The selection of the methods of evaluation of the net effects and the international experience and good practices were examined. Special attention is paid to statistical design of the experiment and a quasi-experimental approach which is used to evaluate the net effect in active labour market policy in Bulgaria.

Keywords. Net effect, Active labour market policy, Quasi-experimental designs, Statistical research.

1. Introduction

During the last decade, the active labour market policy has acquired special importance as ever greater interest is manifested toward it both on the part of the interested parties (unemployed persons, employed persons, employers, etc.) and on the part of the government itself. The active labour market policy is a kind of regulator of the labour market, and it is an invariable element of every National Employment Action Plan, being a proper measure and instrument to tackle unemployment.

The goals of the active policy on the labour market consist in helping both the unemployed persons and the persons from the vulnerable groups, as well as the employers themselves in the overall development of the labour market

The foundational goal of the elaboration of a subsequent assessment of the active labour market policy is to help the process of improvement of the quality and effectiveness of the active policy on the labour market which is financed with funds from the State Budget. The specific goal is to improve the availability of information for the process of taking decisions in the field of the active policy on the labour market in Bulgaria.

These goals can be achieved by developing and estimating the so called net effect of the programs and measures that are financed with funds from the State Budget - for more information see Atanassov (2014). The object of the assessment are the programs and measures included in the National Employment Action Plan based on studying the participants in the labour market.

The results from the assessment can be viewed as an opportunity to improve the employment prospects before the unemployed persons as a result of their participation in the active measures and programs for employment and training.

The main purpose of this report is to review the most common approaches to assessing net effect in active labour market policy in Bulgaria, especially the so called quasi-experimental approach.

2. Some approaches to assessing net effect in active labour market policy based on the international experience and the good practices

Various methods can be used to evaluate the net effect from the active policy on the labour market. To be able to apply any of them, it is necessary to gather statistical information which may come from different sources – some of them are administrative registers, the others used a specially planned statistical (fieldwork) studies. Of course, the best way is to combine these two kind of sources since this is how the most complete picture can be obtained of the programs and measures for employment and training being studied. In the present report, it is recommended during the assessment of the active policies on the labour market in Bulgaria to be combined administrative data about the persons provided by the Employment Agency with a statistical fieldwork study of the effects of the programs and measures for employment and training.

If we should choose the appropriate method of evaluation of the effects from the active policy on the labour market in Bulgaria, we should examine the international experience and good practices. A summary of these methods is presented below.

3. Statistical design of the experiment

One of the famous method by which it is possible to make an appropriate evaluation of the net effects of the programs and measures on the labour market is known in the literature as the statistical design of the experiment. The method is widely applicable in studies in different fields, such as medicine, physics, chemistry, psychology, and, of course, in the study of the net effect from programs and policies on the labour market and elsewhere.

The method consists in that two randomly selected stochastic (representative) samples are taken from the population of unemployed persons at which a program or measure is directed. The assumption here is that the persons from the two samples must have similar characteristics in terms of gender, age, place of residence, level of education, etc.

The only difference between them is that after the samples have been extracted, the persons from the one group (the first sample) have also been included in the programs and measures (this group is called a test group), while the persons from the other group (the second sample) have not participated, nor do they currently participate in the studied programs and measures (this group is called a control group).

All the persons from both groups should be under the influence of the same factors, the only factor in which they differ being that one of the two groups has been included in the programs and measures of the active policies on the labour market, but not the other one. After the completion of the program/measure (usually, at least one year later, so that the factors would have the necessary time to materialize), the results from the test group and the control group are compared. The difference between the average values of the two groups is the evaluated net effect, and it is uniquely the result of the impact of the program. There are programs that are evaluated in this manner, as for example Björklund and Regnér (1996), and some authors, such as Friedlander (1997), warmly recommend it.

Unfortunately, the classic design of the experiment has its deficiencies and strict limitations. It is possible for a deviation in the evaluations to occur due to the fact that the persons from the control group could have been included in the meantime in other programs or measures, and that could distort the results so that the effect would not be the net effect. Furthermore, in order to conduct this experiment, it should be planned and to begin before the launching of the programs and measures. If the evaluation of the programs is done only after

their completion (ex-post evaluation) which is the usual case, then the classic design of the experiment is not applicable.

4. Quasi-experimental approach to assessing net effect

The logic and the underlying principles of the classic design of the experiment have been further developed in the so called quasi-design of the experiment which has the following main advantages as compared to the ordinary design of the experiment:

- The approach has been developed and is applied specifically for subsequent (ex-post) evaluations as in the present case since the classic design of the experiment is not applicable;
- The fieldwork study is done only once, at least one year after the completion of the programs, overcoming in this way the inconveniences that exist in the ordinary design of the experiment where the study goes on for several years;
- The discrimination of the unemployed persons is avoided with respect to their inclusion or non-admission to the programs and measures with the aim of conducting the experiment.

With the quasi-design of the experiment are selected again two stochastic samples: the first one consisting of persons who have been included in the programs and measures (the test group), and the second one consisting of participants who have not been included in the programs/measures (the control group). In order for the comparison of the results of the two samples to be accurate, it is necessary that they should have equal or at least very similar characteristics. In other words, should there be more men or more younger persons in one of the samples and less in the other, then it would be impossible in the final account to make a definitive judgment whether the finding of employment was the result of the active measures on the labour market, or whether it was the result of the characteristics of gender and age. There are various practically established approaches by means of which it is possible to get two samples with equal or with very similar characteristics.

The first approach is to take out **two independent samples** while complying with the principles of formation of stochastic samples. According to the central limit theorem, it can be expected that the average in terms of a certain characteristic in the one sample (say, the average age) would be very close to the average in the other sample. Or, should there be some difference, then this difference would be significantly negligible. Unfortunately, however, if a comparison is to be made of the distribution of the persons from the two samples according to two characteristics simultaneously (say, according to populated place and according to age), then there would most probably be a significant difference between the two samples. Should the comparisons be based on 3 or more characteristics simultaneously, then the differences would be even more pronounced. Therefore, it is impossible to compare the individual persons from the two samples, and the evaluation at the individual level would be impossible to make. Therefore, this approach is not going to be applied.

Judgmental Matching method. This method has been described by Bamberger (2006). The researcher using this method selects characteristics for which the objects of the study (the persons in this case) from the two groups are like each other. This approach is often used when evaluating the effects from the implementation of projects, but it is applicable most of all when the objects (persons) to be studied are a small number. When there is a bigger number of persons to be studied, the application of this method would take too much time and resources, and is therefore impracticable.

Propensity Score Matching method. It is a statistical method by which pairs of persons with similar characteristics are found from the test and from the control group, but not by looking for matching according to their individual characteristics, but by forming groups

of persons where through the use of probabilistic models it is guaranteed to get similarity, and the probability of being included in the control group or in the test group is the same. Rosenbaum and Rubin (1983) have proven that this method is extremely convenient for the formation of a test group and a control group in the subsequent evaluations of the effects from the programs and measures that have been implemented. This is the method used in the study, using in the formation of the pairs of the administrative information gathered by the labour offices for every unemployed person and stored in the "*National Database of the Labour Market and the ESF*" of the Employment Agency in terms of gender, age, education level, administrative district where the person resides, and so on.

The Double Difference method. This method measures the differences in the results between the test group and the control group before and after the active measures on the labour market. For example, if the relative share of the persons from the test group who were able to find a job one year after the completion of the program is 20%, while the same relative share in the control group is 5%, then the net effect from the program that was implemented is the difference between the two relative shares, i.e. 20 - 5 = 15. To achieve maximum effect, this method should be combined with the propensity score matching method since this is how an equal start and a correct comparison are guaranteed.

Econometric models. This approach is used as complementary to the previous ones. With it, an econometric model is constructed in which the resultative variable is the finding of employment, while the factor variables are the inclusion in the programs and measures, the gender, the age, and other characteristics. After the evaluation of the model, the parameters would show the net impact of every individual factor, the impact of the other factors having been eliminated.

When comparing the results between the individual groups of participants and also when proving the individual effects, one must take into account that the information for most of the programs and measures (in Bulgarian assessment usually those with more than 300 participants) has been gathered using representative samples, which means that all the participants in the program/measure were not studied, and the obtained results are valid accordingly for the sample. The end goal, however, is to make an inference for the entire so called statistical population. In other words, the inferences must apply to all of the participants in the program/measure, some of them with many thousands of participants, as is the case for example with the program "Welfare to Work National Programme".

It is possible for the differences in effectiveness between two programs to be the result of the random nature of the samples. In other words, the two programs might in fact be equally effective, but because of the use of samples, some differences might occur. In order to check this and to prove that a certain program/measure is indeed more effective than another, and that the difference is not the result of using samples instead of working with all the participants in the program/measure, statistical test of hypotheses will be made.

In the final account, the inference made from checking the hypotheses refers to the entire statistical population, and it is guaranteed with a certain degree of probability (usually 95%). This can prove that the programs and measures which have been implemented were indeed effective and in which group of participants the effect is markedly greater as compared to the others. For more information on this, see Atanassov (2014).

It is necessary to emphasize that the checks of hypotheses are applied only when work is done with stochastic samples. The smaller programs have been exhaustively studied, which means that the inference from them applies to the entire statistical population, and no checks of hypotheses is needed there.

4. Conclusion

The review of the various approaches for subsequent evaluation of active policy on the labor market shows some advantages and disadvantages of these approaches. The most appropriate method for ex-post evaluation of active measures on the labor market remains the quasi-experimental approach. The method has been already used in a lot of countries in the world, including in Bulgaria. Of course, to implement this method a lot of experts are needed, especially in the field of statistics and researchers on the labour market.

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On the Opportunity of Some Market's Prognosis

Kostadin Sheyretski[1], Meglena Lazarova[2]

[1] University of National and World Economy, Sofia, Bulgaria
sheyretski@unwe.bg

[2] Technical University-Sofia, Sofia, Bulgaria
meglena.laz@unwe.bg

Abstract: In this paper we introduce a market's analysis which is made on the assumption that the market is a dynamic system and all the participants on it are dependent on different factors and connections. In long term we search the reasons for the market's dynamics unpredictability. We investigate the limits in which we can make the prognosis of the market's process.

Keywords: Real property market, Economic model, Dynamic system, Chaos theory

1. Introduction

It is known that economically the market in a given country is dependent on some connections and rules between all the producers and consumers. The producers have the ambition to enhance the amount of their production and to sell it in higher prices. On the other hand the consumers are searching those goods that have lower market prices. In the most cases we see that some customers are ready to pay more money for higher product's quality. A simple question is arisen. What is the main reason of the fact that we can't predict some goods' prices in long term? The answer of this question is hidden in the specific character of some economic processes. When we analyze the market's regularity dependency we impose to describe the simplest relations between the subjects. If we are interested in the concrete moment of the analysis such method of approach is discharged. But if we look further these conclusions can be valid only in a short period of time.

2. The real property's market as a dynamic system

Let us suppose that the banking system in a concrete country decides to reduce the mortgage property's credits. This will be a step which will reflect to the change of the real property's market, because many people will decide to buy a property and thus it will lead to the incensement of the real properties' prices. On the other hand the number of the housing constructions will increase. In real competition conditions this will increase the risk that many construction firms will not be able to cover their obligations to the clients. Respectively the people who have given a big amount of money to the construction firms before the building is built will lose their properties. The increasement of the number of the people who have credit accounts in a given bank will lead to the increasement of the number of the people who will not be able to pay their monthly payments to the bank system. Thus the market's changes will have an influence upon the bank policy and again it will reflect upon the market's dynamics.

From the example above it is clear that the market is introduced as a mathematical model and all the participant in it have complex and mutual connections. This is a nonlinear complex dynamic system. The equilibrium is stable only for a definite period of time. Such stability is reinforced by the inactivity of the economic process. A firm's failure will not reflect

to the system, but series of failures will definitely be determined as a catastrophe.

The accidental factors play an essential role in the equilibrium's stability. Such factors can be some political decisions, nature catastrophe and also some sudden changes in other economic fields' dynamics. On the other hand such change normally is determined by the economic mechanisms. Some periodic system's vibrating are determined by the change of participants' numbers on the market. Also such change can be provoke by the life's standard.

The successful prognosis of the real property's price movement will bring a high profit to some market's participants. Usually if this happens it will be an effect of a good chance instead of a successful analyses. Although is it possible if we use the differential equations' mechanism which can describe the dynamic system to succeed in making good prognoses? To answer this question we will try to search an analogy with another complex dynamic system - the atmosphere.

3. Lorentz's system – the first example for a determine chaos

When we create a mathematical model we usually do two essential things. First of all we describe the local regularities – it means that for a short period of time we are interested in a little change of some system's parameters. These parameters are essential in describing the system's properties. In the most cases it can happen by using the differential and difference equations in the concrete system. The second stage of our work is to define system's possible initial conditions. According to the existence and uniqueness theorem of the solutions it follows that the system's condition can be described in every future moment synonymously. This fact was useful for Laplace in his believe that if there is a supernatural creature which can give the Universe's initial conditions then in every future moment this creature will know what will happen.

The discovering of the determined chaos happens accidently even though against the Laplace's demon many years ago Henri Poincare has many objections. Poincare considers that in some systems the sensitivity about the initial conditions would be so essential that practically it would take infinite accuracy for their determination.

The american physicist Lorentz has examined the thermal convection of a fluid which is warmed up below in the field of the weight's strength. In the given model after a thermal extention the wormer fluid sections became lighter. The Archimedes' strength pushes them up and other colder layers come on their places. Thus Lorentz found out three ordinary differential equatins which inspite of their simplicity have a complex properties. The Lorentz system is the following:

$$\begin{cases} \dfrac{dx}{dt^*} = \sigma.(y - x) \\ \dfrac{dy}{dt^*} = rx - y - xz \\ \dfrac{dz}{dt^*} = xy - bz \end{cases}$$

Here the parameters σ, r, b are nondimensional parameters and x, y, z are variables which describe the process. Lorentz's discovery happened very quickly. He noticed that in one and the same initial conditions after a concrete period of time the system has different values of its variables. Such behaviour is called a determined chaos.

Commonly the dynamic system is doing a complex chaotic movement between two unstable focuses – the stationary points beat back the points which describe the phase trajectory

and also they are moving on a spiral. Starting from an arbitrary point the system goes to unstable focus and there it is moving into a growing spiral. After several rotations the system suddenly goes to the second focus where it begins again to move into a growing spiral. In a period of time it jumps from the second focus to the first one and so on. No regularity is noticed in this movement. The number of the rotations on the spirals and the time for staying around one of the focuses is absolutely stochastic. The main characteristics which determine similar dynamic systems are: the exponential diversion of close trajectories in the variables' space which characterize the system and dissipativity – waste of energy in time.

From the example above it is clear that it's not obligatory that we can prognosticate the system's condition with accuracy in a chosen interval of time. Even though we exclude some sudden phenomena which can change the economic system's behavior and take in mind that the system has a nonlinear and complex structure it is absolutely possible that the system can be chaotic.

4. Market's changes and collisions

The collisions in the system can arise provoked not only by the influence of some external circumstances. For example if some fashion tendency have influence on some groups of customers and they suddenly decide to stop searching a concrete product then it will have a disastrous effect upon the producers of this product. The effect would be more disastrous if the producer is making only this product. Here we have an economic system's special feature which is concerned with the possibilities that their subjects can act coordinately and can change their market behavior without a concrete reason. Often an accidently formed group of consumers begin to grow up on the principle of the snow ball demanding a new influence on the market. This inevitably leads to a change on the market. Of course as far as it is a natural process the producers have the ability to react in the most cases and they can stop eventual disastrous results for their business. But sometimes such actions are impossible. Another example is the technologies' development which impose a new aspect on the market where some products suddenly come out of usage.

5. Conclusions

From the analysis which is made we can conclude that there are some main reasons for the impossible prognosis in long time period of the market's dynamic. These reasons are the following:

1) The influence of the accidental factors upon the economic system is caused by social, political and nature factors
2) The dynamic system's complex structure which can describe the economic processes and also its nonlinearity determine a high sensitiveness to the initial conditions. A chaotic behaviour is also possible.
3) The opportunity for a collision changes in the system.

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Solution Analysis of the Problem for Optimal Distribution of Various Automobile Brands Among the Haulage Garages with Microsoft Excel Program

Miglena Ivanova

University of National and World Economy, Sofia, Bulgaria
ivanova_mg@abv.bg

Abstract. A method for analysis using the resources of Microsoft Excel program, for the solution of the problem for optimal distribution of various brands automobiles among haulage garages is presented in the report. The theoretical setting of the task on the basis of the two phase method and its application with the Microsoft Excel program is illustrated in an exemplary task for optimal distribution of the various automobile brands among the haulage garages. Using the Microsoft Excel program, an analysis of the final solution has been made in order to distribute the optimal availability possible in the haulage garages between different brands.

Keywords. Distribution of the automobile brands among the haulage garages, Microsoft Excel, Solver, automobiles zero mileage, Two phase method.

1. Introduction

Transport is one of the main economics branches and an important factor for the effective and normal functioning of every business. Freight transport connects the production sphere to the sphere of consumption. Performing this function, freight transport connects not only the separate branches of the national economics, but the different country regions in a unified whole. [1]

In the solution of the problem for optimal distribution of the various automobile brands among the different haulage garages, an optimal solution regarding the zero mileage is sought. Under "automobiles zero mileage" it is meant the vehicles' movement when empty, from the haulage garages to the first freight stations in the beginning of the working day (first zero mileages) and from the last offloading stations to haulage garages at the end of the working day (second zero mileages). The independent solving of the problem for decreasing the automobiles zero mileages, usually covers only the first zero mileages. [2]

In order to minimize automobiles zero mileages, the problem for optimal shipping from consignors to haulage garages is solved which is one of the main problems in the operative planning of automobile transport area [2,3], for which solution economic-mathematical methods and models are applied. The problem for optimal shipping from consignors to haulage garages has an important practical meaning for freight vehicles. A closed model of the transport problem with a criterion for optimal distances, in kilometers, between the consignors and the haulage garages is applied for its solving. [2]

The practical application of the transport problem is related with calculating procedures with very large volume and therefore it is appropriate for computer programs to be used that would make the solving easier.

The report presents an aproach to Microsoft Excel Program implementation for the solution of the problem for optimal distribution of various automobile brands among haulage garages. Microsoft Excel is the most powerful and popular program for electronic tables in the

world, and offers several hundred commands for input, formatting, processing and presenting data [4]. The electronic table is a product through which data is created and processed in network of lines and columns having many resources for calculation by formulae setting and analyses of various datasets.

2. Theoretical Setting

The common setting of the transport problem for linear optimization of optimal shipping from consignors to haulage garages is as follows [5,6,7,8]:

m starting points are given – haulage garages $A_1, A_2, ..., A_m$, in which number of available vehicles of given brand are situated respectively $a_1, a_2, ..., a_m$. They have to be distributed in every of the n reception points – consignors $B_1, B_2, ..., B_n$, that have requisites of number of vehicles from the same brand respectively $b_1, b_2, ..., b_n$. It is assumed that there is a transport connection between every pair of starting and reception point. The distances of zero mileage are known l_{ij} $(i = 1,2,...,m;\ j = 1,2,...,n)$ between every haulage garage and every consignor. The plan for optimal distribution of vehicles x_{ij}, that have to be distributed between i – th haulage garage and j – th consignor is sought, so that the summed zero mileages of the vehicles to be minimized. I is assumed that $\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j$, i.e. there is a balance between the sum of available vehicles form a given brand in all haulage garages and the sum of consignor's requisites for the same brand.

Representing the zero mileages l_{11} with l_1, i.e. $l_{11} \to l_1$, $l_{12} \to l_2, \ldots$, $l_{1n} \to l_n$, $l_{21} \to l_{n+1}$, $l_{22} \to l_{n+2}, \ldots$, $l_{2n} \to l_p, \ldots$, $l_{m1} \to l_{s+1}$, $l_{m2} \to l_{s+2}, \ldots$, $l_{mn} \to l_t$, and the number of vehicles sought x_{11} with x_1, i.e. $x_{1\ 1} \to x$, $x_{12} \to x_2, \ldots$, $x_{1n} \to x_n$, $x_{21} \to x_{n+1}$, $x_{22} \to x_{n+2}, \ldots$, $x_{2n} \to x_p, \ldots$, $x_{m1} \to x_{s+1}$, $x_{m2} \to x_{s+2}, \ldots$, $x_{mn} \to x_t$, we derive the following problem for linear optimization:

$$\min\left\{Z = l_1x_1 + l_2x_2 + ... + l_nx_n + l_{n+1}x_{n+1} + l_{n+2}x_{n+2} + ... + l_px_p + ... + l_{s+1}x_{s+1} + ... + l_tx_t\right\} \quad (1)$$

$$\begin{aligned}
&x_1 + x_2 + ... + x_n = a_1\\
&x_{n+1} + x_{n+2} + ... + x_p = a_2\\
&\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\
&x_{s+1} + x_{s+2} + ... + x_t = a_m\\
&x_1 + x_{n+1} + x_{s+1} = b_1\\
&x_2 + x_{n+2} + x_{s+2} = b_2\\
&\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\
&x_n + x_p + x_t = b_n
\end{aligned} \quad (2)$$

$$x_j \geq 0, \quad j = 1,2,...,n,n+1,n+2,...,p,...,s+1,s+2,...,t \quad (3)$$

Thus formulated problem could be solved with the two-phase simplex method [5]. In Phase I the auxiliary problem is solved:

$$\min\left\{L = x_{t+1} + x_{t+2} + \ldots + x_{t+m} + x_{t+m+1} + x_{t+m+2} + \ldots + x_{t+m+n}\right\} \quad (4)$$

$$\begin{array}{l}
x_1 + x_2 + \ldots + x_n + x_{t+1} = a_1 \\
x_{n+1} + x_{n+2} + \ldots + x_p + x_{t+2} = a_2 \\
\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\
x_{s+1} + x_{s+2} + \ldots + x_t + x_{t+m} = a_m \\
x_1 + x_{n+1} + x_{s+1} + x_{t+m+1} = b_1 \\
x_2 + x_{n+2} + x_{s+2} + x_{t+m+2} = b_2 \\
\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\
x_n + x_p + x_t + x_{t+m+n} = b_n
\end{array} \quad (5)$$

$$x_j \geq 0, \quad j = 1, 2, \ldots, n, n+1, n+2, \ldots, p, \ldots, s+1, s+2, \ldots, t, t+1, t+2, \ldots, t+m+n \quad (6)$$

If $\min L = 0$, the initial basic program of the given problem matches the optimal basic program of the auxiliary problem.

If this condition is met, we proceed to Phase II, where the given problem is solved seeking

$$\min\left\{Z = l_1 x_1 + l_2 x_2 + \ldots + l_n x_n + l_{n+1} x_{n+1} + l_{n+2} x_{n+2} + \ldots + l_p x_p + \ldots + l_{s+1} x_{s+1} + \ldots + l_t x_t\right\},$$

But the limiting conditions are taken from auxiliary problem's optimal simplex-table.

3. Coming to an Optimal Solution Regarding Zero Mileages with Microsoft Excel Program for the Problem of Distribution of Various Automobile Brands Among the Haulage Garages

The theoretical setting exposed in (4), (5) and (6) of the transport task allows the resources of Microsoft Excel to be used for coming to an optimal solution regarding zero mileages of the problem of distribution of various automobile brand among the haulage garages using simplex method of the two phases. With Microsoft Excel we can solve closed and open model of transport problems for a short time. To illustrate the developed approach with application of Microsoft Excel we are going to look through the following transport problem:

Two haulage garages are given A_1 and A_2 with maximum capacity of available freight vehicles respectively 35 and 55 pcs and three consignors B_1, B_2 and B_3 with daily requisites respectively of 20, 20 and 20 pcs of the two brands SCANIA and MAN freight vehicles, with consignors' preliminary specified requisites, separate for the two brands SCANIA and MAN. A plan for optimal distribution of the vehicles of the two brands among the haulage garages has to be made which ensures minimum aggregate zero mileages.

The considered transport problem is an open model - the sum of the available vehicles' maximum capacity in the haulage garages is 90 pcs, and the sum of consignor's requisite vehicles is 60 pcs. The formulated open transport problem is solved using a reduction to a closed transport problem. For this purpose, a fictive consignor is introduced - B_4 with volume of requisite vehicles equal to 90–60 = 30 pcs. From a practical point of view, it is the most pertinent, the distances between the two haulage garages to the fictive consignor, to be zero.

The consignors' requisites are given in table 1, separately for the two brands SCANIA and MAN, as well as and the distances of the zero mileages between haulage garages and consignors, for the transport problem considered.

Table 1. Distances in km between haulage garages and consignors

Haulage garages		Distances in km between haulage garages and consignors				Max. capacity. vehicles pcs
		Consignors				
		B1	B2	B3	B4	
A1		2	5	8	0	35
A2		3	10	9	0	55
Daily req. veh. pcs		20	20	20	30	90
Incl. by brands	SCANIA	5	2			
	MAN	15	18	20	30	

Representing the number of vehicles sought $x_{11} \to x_1$, $x_{12} \to x_2$, $x_{13} \to x_3$, $x_{14} \to x_4$, $x_{21} \to x_5$, $x_{22} \to x_6$, $x_{23} \to x_7$ и $x_{24} \to x_8$, the following problem of linear optimization is derived:

$$\min\left\{Z = 2x_1 + 5x_2 + 8x_3 + 0x_4 + 3x_5 + 10x_6 + 9x_7 + 0x_8\right\}$$

With conditions $x_1 + x_2 + x_3 + x_4 = 35$, $x_5 + x_6 + x_7 + x_8 = 55$, $x_1 + x_5 = 20$, $x_2 + x_6 = 20$, $x_3 + x_7 = 20$, $x_4 + x_8 = 30$, $x_j \geq 0,\ j = 1,2,...,8$.

Thus formulated problem could be solved with the two-phase simplex method in Microsoft Excel. For obtaining the optimal solution the false variables x_9, x_{10}, x_{11}, x_{12}, x_{13} and x_{14} are introduced, that are added respectively in the first, second, third, fourth, fifth and sixth equation of the limiting conditions. The auxiliary problem $\min\left\{L = x_9 + x_{10} + x_{11} + x_{12} + x_{13} + x_{14}\right\}$ is solved with the simplex-method at Phase I with the new limiting conditions. The output data for solving the first phase of the problem are put in a Microsoft Excel sheet – the first simplex-table is filled as shown in fig.1.

For obtaining the optimal problem solution regarding the zero mileages using Microsoft Excel on the basis of the two-phase method the mathematical function SUMPRODUCT [9] can be used. For calculating the value of the function $L_0 = \sum_{i=1}^{m+n} l_i d_i$ in the cell $C9$ the formula SUMPRODUCT(A3:A8;C3:C8) is entered, and for calculating the evaluation Δ_1 as $\Delta_j = \sum_{i=1}^{m+n} l_i a_{mj} - l_j,\ \ j = 1,2,..,t+m+n$ in the cell $D9$, SUMPRODUCT(A3:A8;D3:D8)−D1 is entered. To calculate the remaining evaluations Δ_j absolute addressing [4,9-12] is used in the index line and the formula is edited as follows SUMPRODUCT($A$3:$A$8;D3:D8)−D1 The new formula is copied in cells from *E*9 to *Q*9.

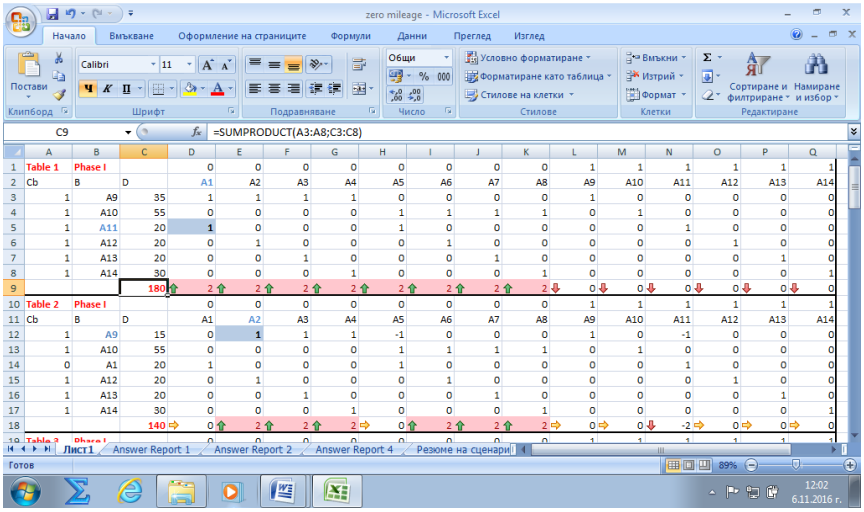

Fig.1. Table 1 and Table 2 of the first phase of the problem solving with Microsoft Excel

The solution of the issue problem of administering the program Microsoft Excel is generated in the second phase of the fourth simplex table. The sought optimal solution providing minimum summed vehicles' zero mileages is $Z_{\min} = 325$ kilometers, as $x_1 = 15$ $x_2 = 20$, $x_3 = 0$, $x_4 = 0$, $x_5 = 5$, $x_6 = 0$, $x_7 = 20$, $x_8 = 30$.

The optimal solution sought, regarding zero mileages for the problem of the distribution of various automobile brand among the haulage garages, could be obtained with the exposed theoretical formulation (1), (2) and (3) of the transport task using the application Microsoft Excel Solver [9,11], as shown on fig.2. When selecting dialog screen *Solver Parameters* of *NonLinear* method an optimal solution is generated, as well when selecting Simplex-method for some transport tasks with more than one optimal solution, another optimal solution is generated.

For undertaking transport task with Microsoft Excel program two optimal basic solutions are obtained. The first one is $x'_{11} = 15$, $x'_{12} = 20$, $x'_{13} = 0$, $x'_{14} = 0$, $x'_{21} = 5$, $x'_{22} = 0$, $x'_{23} = 20$, $x'_{24} = 30$, and the second solution is $x''_{11} = 0$, $x''_{12} = 20$, $x''_{13} = 15$, $x''_{14} = 0$, $x''_{21} = 20$, $x''_{22} = 0$, $x''_{23} = 5$, $x''_{24} = 30$.

4. Analysis of the Final Solution with Microsoft Excel Program to Distribution of the Optimal Possible Capacity of Vehicle Brands Among Separate Haulage Garages

The transport task obtained a specific ability to differ from other linear optimization tasks which consists in obtaining more than one optimal basic solution. In case the transport task has got more than one optimal solution with the illustrated in the report, solution method on the Microsoft Excel program, this feature should be considered. For different transport tasks with more than one optimal basic solution the method presented here in the report can generate three optimal solutions. There are two optimal basic solutions for the examined transport task. The first optimal solution is obtained with Microsoft Excel two- phase method and using Microsoft Excel Solver, and the second solution is obtained with Microsoft Excel Solver only.

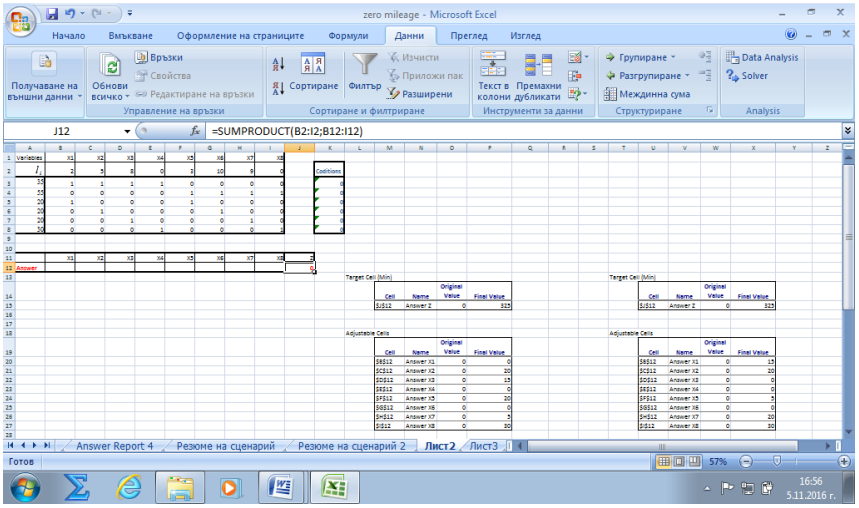

Fig.2. Optimal problem solutions generated with the application Microsoft Excel Solver

After receiving the optimal solution about zero vehicle's mileages the optimal possible availability of relevant brands in different haulage garages must be distributed. For this purpose, sequentially filled cells in the haulage garages are analyzed by optimal base program of the problem. [2] In the last two columns of table 2 the distribution of optimal possible capacity in the haulage garages A1 and A2 between the two brands vehicles SCANIA and MAN for the first optimal solution is illustrated.

Table 2. Distribution of vehicle brands SCANIA and MAN among haulage garages for the first optimal solution

Haulage garages		Number of vehicles				Maximum number of vehicles		
		Consignors				Total	Incl.by brands	
		B1	B2	B3	B4		SCANIA	MAN
A1		15	20			35	2	33
A2		5		20	30	55	5	50
Daily req. veh. pcs.		20	20	20	30			
Incl.by brands	SCANIA	5	2					
	MAN	15	18	20	30			

The result that both haulage garages A_1 and A_2 are filled with the same brands SCANIA and MAN, what is impractical in terms of the organization of maintenance, repair and supply of the vehicles. Before completely accepting the final distribution of different brands among haulage garages it is necessary to analyze with a view to eliminate various types of vehicles through displacement of a minimum number of vehicles of a brand. There are three options to reduce different types in the haulage garages: **Option 1** (**zero mileage 1)** – transferring 2 cars of SCANIA brand from the cell A_1B_2 to the cell A_2B_2 and 2 cars of MAN brand from the cell A_2B_3 to the cell A_1B_3, **Option 2** (**zero mileage 2)** –

transferring 2 cars of SCANIA brand from the cell A_1B_2 to the cell A_2B_2 and 2 cars of MAN brand from the cell A_2B_4 to the cell A_1B_4 and **Option 3 (zero mileage 3)** – transferring 5 cars of the SCANIA brand from the cell A_2B_1 to the cell A_1B_1 and 5 cars of the MAN brand from the cell A_1B_2 to the cell A_2B_2. To determine the final option of different vehicle brands' distribution among the haulage garages the opportunities of Microsoft Excel program could be used for ***What-if* analysis (counterfactual analysis)** [9,10,11,13].

By selecting functions ***Data – What-if Analysis – Scenario Manager – Summary*** to analyze the possible options through changing cell values with tracking the effect on the result of worksheet calculations a summary of the three options for vehicle's dislocation is obtained in fig.3. The result from Microsoft Excel program analysis of the final solution aimed to allocate the optimal possible availability in separate haulage garages between different vehicle's brands is as follows: In case of the first option of vehicle's dislocation (**Zero mileage 1**) it's obvious that summarized zero mileages are 333 vehicle kilometers, which is 2,47% higher in comparison with the received by the optimal option 325 vehicle kilometers; in case of the second option (**Zero mileage 2**) the summarized zero mileages are 335 vehicle mileages, which is 3,08% higher in comparison with the optimal option, and in case of the third option (**Zero mileage 3**) the summarised zero mileages are 345 vehicle kilometres, which is 6,2% higher in comparison with the optimal option.

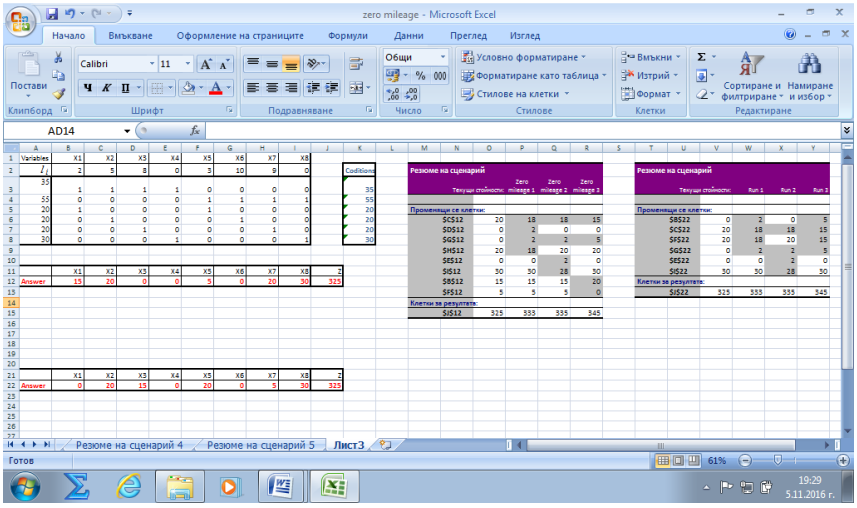

Fig.3. Analysis of the first and second optimal solution of the task using Microsoft Excel

For the second optimal solution it's sought that the distribution of maximum number of vehicles in the haulage garage A_1 is 2 cars of SCANIA brand and 33 cars of MAN brand, and the distribution of maximum number of vehicles in the haulage garage A_2 is 5 cars of SCANIA and 50 cars of MAN brand. In fig.3 a summary of possible options' scenario is introduced for vehicle's replacement and for the second optimal solution of the problem. The analysis result of the second optimal solution is next: in case of the first option of vehicles' relocation (**Run 1**) it is obtained that summarized zero mileages amount to 333 km per vehicle, and for the second option (**Run 2**) it is obtained, that summarized zero mileages amount to 335

km per vehicle, and for the third option (**Run 3**) the summarized zero mileages amount to 345 km per vehicle.

The less value of additional raise in zero vehicle mileages, the higher is possibility to be economically viable to relocate different vehicle brands among haulage garages in order to reduce different types. In a minor additional decrease of zero mileages it's not necessary to make comparisons between net savings for costs of maintenance and vehicle's repair in connection with the additional zero mileages. In such cases it may simply be accepted distribution, thus provided less vehicle's variability in the haulage garages. [2]

Microsoft Excel program analysis of the optimal problem solution aimed a distribution of maximum possible availability in separate haulage garages between the respective vehicle brands and for the two optimal solutions it is obvious, that the option with the summarized zero mileages amount to 333 km per vehicle (the zero mileages'increase is 2.47%) is economically more profitable and that is why it should be adopted.

5. Conclusion

Three main results in the report are obtained.

First of all, the presented theoretical formulation of transport tasks' solution on the basis of the two-phase method can be administered for closed and open model transport problems.

On the second place, with the presented method applying Microsoft Excel program up to three different optimal solutions of the transport problems with more than one solution can be generated.

On the third place is the described method of analysis with the Microsoft Excel program of the optimal problem solutions with a view to eliminating the vehicle brands' diversity in the separate haulage garages dislocating minimum number of a brand, which automates the production of cost-effective and more economical option.

It's author's opinion, that the report contribution is in proposing an original problem solution of the optimal distribution of different vehicle brands among haulage garages applying Microsoft Excel program.

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Numerical Modeling of Dynamics of Economic Systems with Time-Delay

Ivan N. Dushkov[1], Ivan P. Jordanov[2]

[1] FPPSE - Sofia University St. Kliment Ohridski, Sofia, Bulgaria
i_dushkov@mail.bg

[2] University of National and World Economy, Sofia, Bulgaria
i_jordanov@email.bg

Abstract. The equations with time delay are a generalization of ordinary differential equations. In the study of real systems with after-effect in quality of output an approximation it is assumed that the delay is kept constant. Such consideration represents a kind of step forward compared to the "ideal" process, which is obtained assuming that "tripping" is not derived instantaneously. In other cases, such an assumption describes a process of partial approximation. Mostly complete analysis shows that in rare cases important to real systems, the continued depends not so much of the time, but also by themselves requested features, as well as their derivatives. In some cases, naturally implies that this dependence does not a determinant. In this paper we discuss a system of three interacting agent systems for the cases with time delay. Many processes in economy are described by the system of ordinary differential equations. Such models are effective in the study of the evolution of economic systems over long periods of time. We know that delay the introduction of information into dynamic models change their properties. The theoretical conclusions are illustrated with well-known economic model Dimitrova-Vitanov, which introduce a time delay. The system of model equations for this case is a system of three ordinary differential equations with time-delay. When time delays are introduced in these model equations, the resulting system describes the influence of delay on the respective evolution processes. We will show how use a modification of the method of Adams for the numerical solution of the system of model equations with time delay.

Keywords. Time delay, economic systems with after-effect, method of Adams, Dimitrova-Vitanov model.

1. Introduction

Many processes in economy and social sciences are described by the system of ordinary differential equations. Applications of differential equations are now made in modeling many areas of science. The dynamic theory has become an essential tool of economic analysis particularly since computer has become commonly available. Others important fields of mathematical economy are partial differential equations, stochastic processes, time series analysis, and dynamics with delay, which have also been applied to different fields of economics [8, 31, 36 - 38], social sciences [29, 30], population dynamics [15 - 19], technologies and medicine [9 - 14, 20 - 28, 32 - 35]. Such models are effective in the study of the evolution of economic systems over long periods of time.

We know that delay the introduction of information into dynamic models change their properties. Widely known are specific economic models (model of business cycles Goodwin, Kaldorian macro dynamic model, Kaleckian investments lag and oligopoly model Cournot),

illustrating that with delays more complex dynamics can occur. We know that these two models (without delay) generate the same dynamics, if the delay is small enough. However, this is not true if the delay is greater.

2. The Model with Time Delay

As we noted above in papers [4 - 7] Dimitrova and Vitanov have been studied and solved numerically (in various suitably selected values of the parameters) the following systems ordinary equations:

$$\frac{dN_i}{dt} = r_i^0 N_i \left[1 - \sum_{j=1}^{n} (\alpha_{ij}^0 - r_i) N_j - \sum_{j=1}^{n} \sum_{l=1}^{n} \alpha_{ij}^0 (\alpha_{ijl} + r_{il}) N_j N_l - \sum_{j=1}^{n} \sum_{k=1}^{n} \sum_{l=1}^{n} \alpha_{ij}^0 r_{ik} \alpha_{ijl} N_j N_k N_l \right],$$

where r_i is the growth ratio of the *i*-th agent system and α_{ij} is the interaction coefficient measuring to what extent the growth of the *i*-th agent system is influenced by the *j*-th. We agent system assume, that both coefficients are density dependent and that they depend on the density of the members of the agent systems in the following manner:

$$r_i = r_i^0 \left[1 + \sum_{k=1}^{n} r_{ik} N_k \right], \tag{1}$$

$$\alpha_{ij} = \alpha_{ij}^0 \left[1 + \sum_{k=1}^{n} \alpha_{ijk} N_k \right]. \tag{2}$$

If we lay:

$$r_i^0 = f_i^0,$$
$$r_i^0 \alpha_{ij}^0 = -f_{ij} - b_{ij}^0,$$
$$r_i^0 \alpha_{ij}^0 (\alpha_{ijk} + r_{ik}) = -b_{ijk},$$
$$r_i^0 \alpha_{ji}^0 r_{ik} \alpha_{ijl} = 0,$$

we get:

$$\frac{dN_i}{dt} = N_i \left[f_i^0 + \sum_{j=1}^{n} (f_{ij} + b_{ij}^0) N_j + \sum_{j,k=1}^{n} b_{ijk} N_j N_k \right]. \tag{3}$$

With such indications entered the system is converted to the system discussed in Arneodo et al. [1 - 3], and additional members, caused by adaptation effects.

Let us now introduce the constant time delay $\tau > 0$ in the system. Thus we obtain a system of ordinary differential equations with time delay:

$$\frac{dN_i(t)}{dt} = N_i(t-\tau) \left[f_i^0 + \sum_{j=1}^{n} (f_{ij} + b_{ij}^0) N_j(t-\tau) + \sum_{j,k=1}^{n} b_{ijk} N_j(t-\tau) N_k(t-\tau) \right]. \tag{4}$$

3. Modified Numerical Method of Adams

The performance of the task of solving the system (4) required to be set initial function $\varphi(t)$ in the interval of the type $[-\tau, 0]$. Because our task is to examine the decision of the system in the presence of a time delay we will believe that this function is a solution of the same system, without the time delay.

Let's assume a normal system of ordinary differential equations with constant time delay τ:

$$\frac{dN_i(t)}{dt} = F_i\left[N_1(t-\tau), ..., N_n(t-\tau)\right]. \tag{5}$$

Let the initial function $\varphi(t)$ are defined in the interval $[-\tau,0)$. We divide the interval of k equal parts by the points $\{-\tau+l.h\}$, where $l = 0,...,k$. Due to the requirement $-\tau+k.h = 0$, for step h we get that $h = \tau/k$. Once known values of initial function in the points above will look approximation of the decision at the point $t = m.h$, $m>0$.

Similarly Multistage methods for solving system ODE we can integrate both sides of each of the equations of the system with respect to t ranges from t_{m-l} to t_m:

$$\int_{t_{m-l}}^{t_m} \dot{N}_i dt = \int_{t_{m-l}}^{t_m} F_i[N_1(t-\tau),...,N_n(t-\tau)]dt \tag{6}$$

or:

$$N_i^m - N_i^{m-l} = \int_{t_{m-l}}^{t_m} F_i[N_1(t-\tau),...,N_n(t-\tau)]dt . \tag{7}$$

Then, if the integral substitution of variables $t=t_m+h.x$, we get:

$$N_i^m - N_i^{m-l} = \int_{-l}^{0} F_i[N_1(t_m + x.h-\tau),...,N_n(t_m + x.h-\tau)]dx, \tag{8}$$

but we consider that $F[N(t+h.x-\tau),..., N(t+h.x-\tau)] = \dot{N}(t+h.x)$ we get:

$$N_i^m - N_i^{m-l} = h\int_{-l}^{0} \dot{N}_i(t_m + x.h)dx . \tag{9}$$

Now by applying the formula of Newton interpolation back to the starting point t:

$$\dot{N}_i(t_m + xh) = \dot{N}_i^m + \frac{x}{1!}\Delta\dot{N}_i^{m-1} + \frac{x(x+1)}{2!}\Delta^2\dot{N}_i^{m-2} + ... + \frac{x(x+1)...(x+k-1)}{k!}\Delta^k\dot{N}_i^{m-k} + R_k(x) \tag{10}$$

where for finite difference forward we have:

$$\Delta^l\dot{N}_i = \sum_{l=0}^{k}(-1)^{k+l}\binom{k}{j}\dot{N}_i^{m-k+l} \tag{11}$$

and substitute in (2.8), we get:

$$\frac{N_i^{m+l} - N_i^{m-l}}{h} = \int_{-l}^{0}(\dot{N}_i^m + \frac{x}{1!}\Delta\dot{N}_i^{m-1} + ... + \frac{x(x+1)...(x+k-1)}{k!}\Delta^k\dot{N}_i^{m-k})dx + \int_{-l}^{0} R_k(x)dx \tag{12}$$

We see that to get the value of the solution at the point t_m, we must use the values in the points t_{m-j-k}, which is why when calculating the first approximation (for *0* point), we can use the above method only when $l = 1$. At s-th next approximation we can use the method and amounts to l from 1 to s. Note that for $l = 0$ the above method has a local error of approximation $O(h^{k+1})$.

4. Conclusion

In this article, we received a modification of the known Adams for numerical solution of model system of ordinary differential equations with constant time delay describing the dynamics of the interaction of economic and social systems. This modification can be applied for solving numerical systems and other areas - for example, problems associated with long-term forecasts in the economy, in the social sciences and in many other areas of science and technology that are constantly growing. For the above reasons described method promising for future research in economics and social sciences.

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Spatio-Temporal Modeling in Mathematical Epidemiology

Kiril Mihaylov[1], Elica Ilieva[1], Mario Iliev[2]

[1]Faculty of Mathematics and Informatics, Sofia University St. Kl. Ohridski, Sofia, Bulgaria
kirilmihaylov94@gmail.com, elica95@mail.bg

[2]Faculty of Physics, Sofia University St. Kl. Ohridski, Sofia, Bulgaria
ozo@phys.uni-sofia.bg

Abstract. Mathematical epidemiology differs from most sciences in that it can be not verified experimentally due to the fact that experiments are impossible as practical and certainly unethical. This sets the great importance of mathematical models as a means of comparing different strategies and plans for dealing with an epidemic or pandemic, and to take action to deal with the disease. In classical models for parameter state we take the number of individuals infected and / or cured of the disease, as well as fatal. To limit the spread of the disease is important that we know the spatial distribution of the sick. When we use mathematical modeling this means that the parameter of state must choose the appropriate densities of different groups - infected healthy etc. In this paper we will discuss some popular models of epidemics receive a general mathematical model, without going into technical details. This model consists mainly from system parabolic partial differential equations and can help us to understand the processes of spatial and temporal behavior of the relevant phenomena.

Keywords. Mathematical epidemiology, spatio - temporal modeling, parabolic partial differential equations, SIR - model.

1. Introduction

The dynamics of many systems in the biological, physical and social sciences is modeling ordinary differential equations (ODEs). The dynamic theory has become essential tool for analysis, especially since the computer became generally available. In recent decades, mathematical modeling is necessary to use model systems and nonlinear ODEs [1-5], partial differential equations (PDEs) [14-18, 26, 27] and dynamics immediate [6-13, 20-25, 28-32]. Such models already successfully applied for various fields of social sciences, population dynamics and medicine [14-18, 20-21, 33-38]. Epidemiology studies the distribution of various infectious diseases. Due to the nature of this study is difficult and often impossible to carry out control experiments. Such mathematical models are very useful in our attempts to understand infectious diseases. The introduction of the two dimensional densities in the model allow us to analyze and even predict the outcome of different outbreaks before they even occur.

2. A Epidemic Models

Suppose that the disease, which mold has only two possible outcomes for the patient - healing, to acquire permanent immunity or death. In this model does not distinguish between immunized and the dead, they will constitute a class called eliminated. Amongst removed and put patients quarantined. In this case, the population can be distributed into three classes: S - susceptible (those who can be infected by the disease), I - infected (those who have already contracted the disease and can pass it), R - removed. The movement of individuals in different

classes can be represented schematically as follows:

$$S \to I \to R. \quad (1)$$

Such models called SIR models. There are other models, such as SI, SEIR model, where SI have only two classes contaminated and infected, and SEIR has class-susceptible S, class E which describes individuals where the disease is in its infancy, class of infected I, and class the abolished R. Assumptions made about the transmission of infection and the rate at which individuals move from class I to class R as critical for each model. With S (t), I (t), R(t) denote the number of individuals in each class at a time t.

We see cases where different classes are evenly mixed. All subjects are equally likely to come into contact with each other. This mainly assumption in many situations is not valid, such as the transmission of infection sexually. Based on previous deliberations, the model takes the following form:

$$\frac{dS}{dt} = -aSI, \quad \frac{dS}{dt} = -aSI - bI, \quad \frac{dS}{dt} = bI \quad (2)$$

Here a > 0 is the rate of infection, and b> 0 is the speed of removal of the infected. This is the classic model [1, 19]. We, of course, are only interested in non-negative solutions for the classes S, I and R. This is the basic model from which we can draw some conclusions that are essential to epidemics and to adequately describe some specific outbreaks. Parameters of the state have taken the number of individuals in the respective classes. if you are interested in the spatial distribution of these individuals, we need to introduce parameters density of individuals from the respective classes, which we will do in the next point.

3. Spatial - Temporal Model

Let us now look at the spatial distribution of the three groups, i. e. S - unaffected by the disease, I - those concerned and R - those can no infect. Then, if we take any sufficiently small playground facing dσ, about an arbitrary fixed point of the field, which have respectively dS, dI and dR - the number of individual group can determine the density of the group at a given point, such as:

$$\rho_s(\vec{r},t) = \frac{dS}{d\sigma}, \rho_I(\vec{r},t) = \frac{dI}{d\sigma}, \rho_R(\vec{r},t) = \frac{dR}{d\sigma}. \quad (3)$$

All of these densities varies with the passage of time. This amendment is due to the change in the number of individuals from different groups and the entry of individuals (i. e. migration) across the border of the site.

The change in the number of individuals of the three groups in the area (not counting migration) is given by functions:

$$F_s(\vec{r},t) = -aSI, F_I(\vec{r},t) = aSI - bI, F_R(\vec{r},t) = bI. \quad (4)$$

Then time dt face dσ, ie the point will have:

$$dS = dS^{vol} + dS^{migr},$$
$$dI = dI^{vol} + dI^{migr},$$
$$dR = dR^{vol} + dR^{migr}. \quad (5)$$

We consider the migration receive system parabolic equations:

$$\frac{\partial \rho_S}{\partial t} - D_S \Delta \rho_S = -aSI ,$$
$$\frac{\partial \rho_I}{\partial t} - D_I \Delta \rho_I = aSI - bI ,$$
$$\frac{\partial \rho_R}{\partial t} - D_R \Delta \rho_R = bI . \qquad (6)$$

The above model already described and the spatial distribution of the different classes.

4. Conclusion

In this article, we discuss model system of parabolic partial differential equations description of the spatial-temporal dynamics of the spread of epidemics. It is the presence of spatial dimensions of our model allows us to explore the movement of members of the respective groups in space. In practical terms, eq. (6) can be used for possible prediction and control of the spread of an epidemic, such as within a specific region. Morbidity and mortality are often available from statistical data. From these sources may derive estimates of the coefficients in the model. We can simulate eq. (6) with known or appropriate initial conditions. In this way we can get estimated picture of the development of the epidemic in the observation area for a certain period of time.

Finally, we note that the overall shape of the model represented by eq. (6) can be used to describe the dynamics of other epidemics / pandemics.

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Integration of ICT in Teaching Mathematics Classes for Extracurricular Activities (Poisson Problem)

Ivan N. Dushkov[1], Vasil M. Mladenov[2]

[1] Faculty of Preschool & Primary School Education, Sofia University „St. Kl. Ohridski"
i_dushkov@mail.bg

[2] 21 High School "Hristo Botev", Sofia, Bulgaria
wasilmladenow@gmail.com

Abstract. In 21 century defined by many as the century of information technologies, increasingly is felting the need for adequate and modern education. An excellent solution for this is information and communication technology. It contributed to find the necessary balance in schools, to hold the interest of students and to experience the spirit of the new multimedia lessons in the modern educational process. 10 years ago in FNPP it was started working on the implementation of ICT in education in elementary schools with the launch of a Master program " Information Technology in elementary school" led by Prof. Zdravko Lalchev /then Associate Professor/ [3, 4]. The program launched theoretical and applied research on the topic "Computer teaching presentations in the teaching of mathematics in primary schools". The present report presents an idea to integrate such presentations in classes for extracurricular activities in mathematics through problem Poisson.

Keywords. Information technologies, ICT in education, computer teaching presentations, classes for extracurricular activities.

1. Introduction

Information and communication technologies (ICTs) are a term used to refer to all computer and communication technologies (most often used together). The term "information and communication technologies" (ICT) has a broader meaning, covering all known ways and means of exchanging information by radio, television, mobile phones, computer hardware and software, satellite systems and so on, as well as various types of services and applications associated with them, such as video conferencing and distance learning. According in E. Rusten [7] computer use in education help integrate students into modern development environment for advanced technology. The development of modern methods and means of training highlighted the widespread use of computers. In the training process widely penetrate them. Such are computer training systems (CSR) E-learning (UNCCD), computer-assisted learning (KPA), remote training systems (web-based learning and multimedia systems) and others.

In the revised interactive educational environment in the foreground stand out several priorities:

1. Motivation to learn: In the process of solving problems through interactive methods student becomes motivated, and hence the desire to teach.

2. Game methods: specificity of interactive learning requires it to be entertaining, with many playing exercises pleasant and enriched with new, continuously advanced interactive training tools.

New forms of communication [1], [2], [5], [6]: multimedia projector replaces the slides and camcorders to mobile computers - old film equipment. Combined training for those working in team teachers through an exchange of interactive lessons online contacts as well as published on the website of teacher innovators.

In this paper we look at a sample task in mathematics intended for extracurricular activities. For this purpose we have prepared a presentation that could be used both to help teachers and for independent work of students.

2. Poisson Problem

The problem Poisson named after its creator - the famous French mathematician and physicist Siméon Denis Poisson. He was born in France on 21.06.1781 and had died as on 25.04.1840.

It is a logical problem transfusion fluid without the help of measure. In its resolution are eligible only such transfusions from one container to another, which becomes maximum filling and / or maximum discharge of any of the dishes.

For training purposes we have created a series of original presentations in which we examined two cases of this task, namely:

1. We have three vessels with capacity accordingly 8, 5 and 3 liters. The biggest is filled with liquid and the other two are empty. For the distribution of the fluid in two equal parts, we only those three container units.

This object is achieved by implementing several steps, presented in the Table 1.

These eight steps are the overflow of liquid from one container to another.

Table 1

	container1	**container2**	**container3**
step 1	8	0	0
step 2	3	5	0
step 3	3	2	3
step 4	6	2	0
step 5	6	0	2
step 6	1	5	2
step 7	1	4	3
step 8	4	4	0

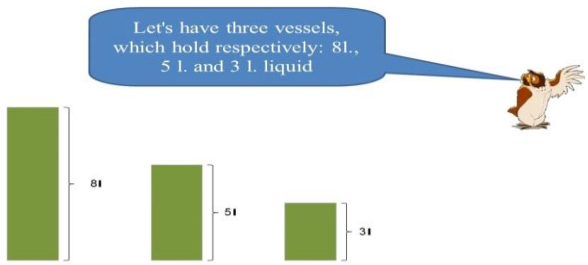

figure1

To illustrate solution of the problem we have created a multimedia presentation consisting of nine slides, the first a header and the other presented the decision itself.

The slides have the same design as in each participating cartoon character Mr. Owl, which gives guidance to students to solve the problem. On each slide has a "Help" button, using which goes to the next step. This continues to completely solve the problem. With effect Wipe fill or empty containers by selecting the relevant direction (up or down):

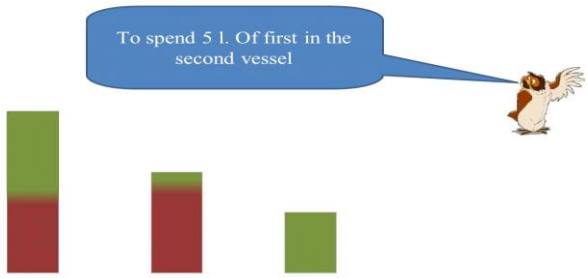

figure2

After decanting the liquid in the set indication appears on the content of each of the vessels, thereby achieving greater clarity:

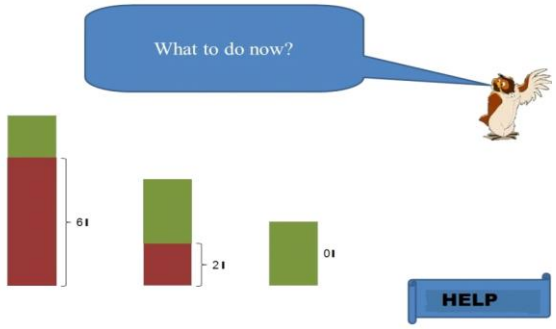

figure3

This style is respected throughout the presentation in order not to disturb its entirety.

The problem could be adversarial. It could take into account the outcome at a time or number using the "Help" button.

2. One person has 12 liters milk. He wants to give his friend six liters, but you cannot measure it. How can with the least possible transfers to be released exactly six liters of milk?

The second presentation in this cycle presents another version of "Poisson Problem". As in the previous embodiment, here again we can divide the decision of the steps shown in the Table 2.

These are the seven steps that show the overflow of liquid from one container to another.

In order to visualize the decision of the task again created under multimedia presentation consisting of eight slides, the first is a header and the other presented the decision itself step by step with the necessary explanations.

In the presentation again used the cartoon character Mr. Owl, whose goal is to assist students in solving the problem.

Table 2

	container1	container2	container3
step 1	12	0	0
step 2	4	8	0
step 3	4	3	5
step 4	9	3	0
step 5	9	0	3
step 6	1	8	3
step 7	1	6	5

Again used the effect Wipe, which is achieved through better visualization close to reality, namely the very overflow liquid in one vessel belongs at the expense of the other. Again, we can take the outcome at a time by using the "Help" button. The appearance of individual slides is the same as in the previous presentation below:

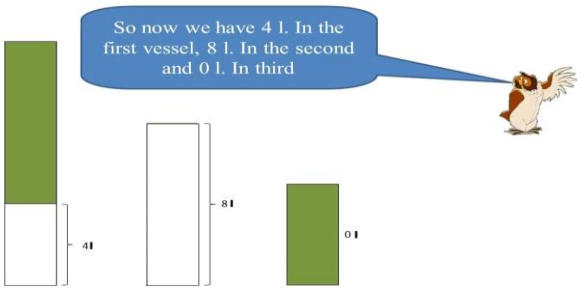

figure4

Again, for simplicity is shown measures the remaining liters of liquid in each of the vessels. As in the previous presentation below and here Mr. Owl first expresses an operation and then automatically liters remaining in the vats appear. This is done in order to improve clarity.

Button for assistance may be used until it reaches the final decision of the task:

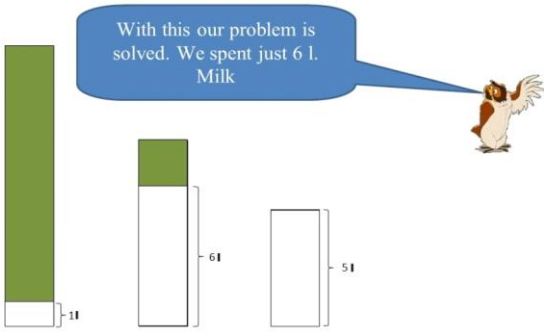

figure5

3. Conclusion

Extracurricular activity breaks within a traditional lesson is for school work. It is a performed with respect to the objectives, tasks and content of a particular subject with which it is associated. Extracurricular activities provides an opportunity to enrich the content provided in the curriculum and program to broaden and deepen their knowledge of relevant academic discipline, to form communication, research and other skills of the students, stimulated the development of consciousness. In informal and interesting activities children are enriched with knowledge from different fields, expanding their mental horizons, increases range of public interests. A perspective of each participant to realize he and his spiritual potentials, stimulate construction of personal strategies for success, cooperation and prosperity, a new way of thinking. Students acquire valuable skills and abilities as a viable means of self-realization and full realization of talents, deployment of forces, the talents of each student.

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Application of the Method of the Simplest Equation for Solving PDEs with Quadratic Nonlinearities

Nikolay K. Vitanov[1], Ivan P. Jordanov[1, 2]

[1] IMECH - BAS, Sofia, Bulgaria
vitanov@imbm.bas.bg

[2] University of National and World Economy, Sofia, Bulgaria
i_jordanov@email.bg

Abstract. Mathematical modeling using partial differential equations and systems is a summary of classical dynamic systems. These models are particularly suitable for describing processes of migration in social systems. In this paper, general model parabolic partial differential equations are reduced to equation with square nonlinearity. This equation is known as the Fisher equation. Thus, in the case that we are dealing with a social group (agents) and for each spatial dimension we obtained a parabolic partial differential equation with non-linearity of the second order. Applying the method of simple equation, we get the exact solutions of this equation.

Keywords. Agents systems PDE, nonlinearity of second order, social agents, Fisher equation, modified method of simplest equation.

1. Introduction

The agent models are an important tool for the analysis of complex systems []. Depending on the nature of the system, the agents may have a variety of properties, as well as to interact in a different way. In recent years there has been rapid development of the agent models because with their help we can adequately describe the processes in a number of economic and social systems. Nonlinearities arise in the model equations of such systems due to interactions among the individuals, and the limitations in the environment. Such nonlinear model systems require applying methods of nonlinear dynamics [1 - 3, 7, 12 - 20], chaos theory [8], and theory of stochastic processes [4].

If the number of economic agents and chaos in their behavior is small, it is possible to describe the system of interacting agents with more or less - less complicated systems of ordinary or partial differential equations. Such systems should describe the characteristic of the collective behavior of agents (their movement in space). We need just such modeling is required to describe the interactions between different economic groups of agents. Therefore, the deterministic model using the various kinds of systems, differential equations is widely spread further. There are different methods for the preparation of a solution of these systems of equations. Some of them are obtained values of the solution corresponding to the specified time and space coordinates. In some cases, however, a good idea will give us the decision itself, although derived under appropriate assumptions about its type. We note the papers of Kudryashov [9 - 11] who advises us to be careful when using the methods for obtaining of exact solutions of the nonlinear differential equations.

In this paper, the general pattern is reduced to analytical derived partial differential equations (PDE) with polynomial nonlinearity in the second row. For the case of a social group agents and one spatial dimension we have obtained a partial differential equation of the second

line, known as the equation of Fischer. The application of the modified method of simplest equation we obtain new exact solutions of this equation.

2. Modified Method of Simplest Equation

Let us briefly describe the modified method of simplest equation [23], which is a powerful tool for obtaining exact and approximate solutions of nonlinear PDEs. We have to solve a partial differential equation and let by means of an appropriate this equation be reduced to a nonlinear ordinary differential equation, cited below:

$$P(F(\xi),\frac{dF}{d\xi},\frac{d^2F}{d\xi^2},...)=0. \quad (1)$$

For a large class of equations from the kind (1) exact solution can be constructed as finite series:

$$F(\xi)=\sum_{\mu=0}^{\nu}P_\mu[\Phi(\xi)]^\mu, \quad (2)$$

where $\nu>0, P_\mu$ are parameters and $\Phi(\xi)$ is a solution of some ordinary differential equation referred to as the simplest equation. The simplest equation is of lesser order than (1) and we know the general solution of the simplest equation or we know at least exact analytical particular solution(s) of the simplest equation. The modified method of simplest equation can be applied to equations of the kind:

$$E(\frac{\partial^{\omega_1}F}{\partial x^{\omega_1}},\frac{\partial^{\omega_2}F}{\partial t^{\omega_2}},\frac{\partial^{\omega_3}F}{\partial x^{\omega_4}\partial t^{\omega_5}})=G(F) \quad (3)$$

where $\omega_3=\omega_4+\omega_5$. In the paper [23], the application of the modified method of simplest equation is based on the following steps:

1) By means of an appropriate ansatz (for an example the travelling-wave ansatz) the solved class of nonlinear PDE of kind (3) is reduced to a class of nonlinear ODEs of the kind (1);

2) The finite-series solution (2) is substituted in (1) and as a result a polynomial of this obtained. Value (2) is a solution of (3), if all coefficients of the obtained polynomial of are equal to 0;

3) By means of a balance equation one ensures that there are at least two terms in the coefficient of the highest power of. The balance equation gives a relationship between the parameters of the solved class of equations and the parameters of the solution;

4) The application of the balance equation and the equalizing the coefficients of the polynomial of to 0 leads to a system of nonlinear relationships among the parameters of the solution and the parameters of the solved class of the equation; 5) each solution of the obtained system of nonlinear algebraic equations leads to a solution a nonlinear PDE from the investigated class of nonlinear PDEs.

3. Application of the Method of Simplest Equation

The system describing space and time for interaction agent systems is [5, 6, 21, 22, 24-27]:

$$\frac{\partial\rho_i}{\partial t}-\sum_{j=1}^{2}D_{ij}\frac{\partial^2\rho_i}{\partial x^2}=F_i(\rho_1,\rho_2,...,\rho_n),\ i=1,2,...,n. \quad (4)$$

When we take only one agent systems we get the parabolic equation:

$$\frac{\partial \rho}{\partial t} - D\frac{\partial^2 \rho}{\partial x^2} = F(\rho).$$

Now as we consider that we have a quadratic nonlinearity we come to the Fischer equation:

$$\frac{\partial \rho}{\partial t} - D\frac{\partial^2 \rho}{\partial x^2} = G\rho^2 + H\rho. \tag{5}$$

Let us now we lay in the above equation:

$$\xi = x - vt, \rho(x,t) = \rho(x - vt) = \rho(\xi). \tag{6}$$

Then from equation (5), we get:

$$D\frac{d^2\rho}{d\xi^2} + v\frac{d\rho}{d\xi} + G\rho^2 + H\rho = 0. \tag{7}$$

We assume that $\rho(\xi)$ has the form:

$$\rho(\xi) = \sum_{i=0}^{n} a_i \exp(i\varphi), \quad \frac{d\varphi}{d\xi} = \sum_{j=0}^{r} c_j \exp(j\varphi). \tag{8}$$

For this case

$$\rho(\xi) = a_0 + a_1\exp(\varphi) + a_2\exp(2\varphi), \quad \frac{d\varphi}{d\xi} = c_0 + c_1\exp(\varphi). \tag{9}$$

When we substitute the above in the equation (7), we obtain the following system of algebraic equations:

$$\begin{aligned}
&6Da_2c_1^2 + Ga_2^2 = 0,\\
&2Da_1c_1^2 + 10Da_2c_0c_1 + 2va_2c_1 = 0,\\
&3Da_1c_0c_1 + 4Da_2c_0^2 + va_1c_1 + 2va_2c_0 + G + 2Ga_0a_2 + Ha_2 = 0,\\
&Da_1c_0 + va_1c_0 + 2Ga_1a_0 + Ha_1 = 0,\\
&Ga_0^2 + Ha_0 = 0.
\end{aligned} \tag{10}$$

One solution to this system is for example (c_1 is a free parameter):

$$\begin{aligned}
&a_2 = \frac{-6Dc_1^2}{G}; a_1 = \frac{6c_1(5Dc_0+v)}{G}; a_0 = \frac{(161D^2c_0^2+66vDc_0+7v^2-HD)}{2DG};\\
&c_0 = -\frac{v}{5D}; v = \frac{5\sqrt{6HD}}{6};
\end{aligned} \tag{11}$$

In this way from (9) we get:

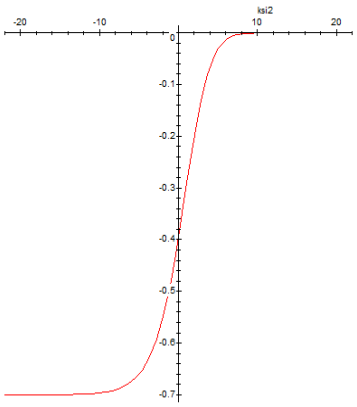
$$\rho(\xi) = -\frac{6Dc_1^2}{G}exp(2\varphi), \frac{d\varphi}{d\xi} = c_1 exp(\varphi) - \frac{\sqrt{6HD}}{6D}, \tag{12}$$

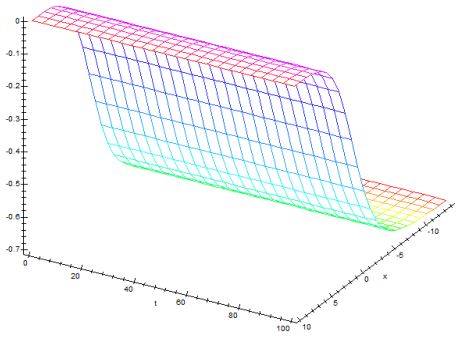
and when we decide the second of the above equations we get the solution of the equation (5):

$$\rho(\xi) = \rho(x - vt) = -\frac{36HD^2c_1^2}{G\left[6Dc_1 - exp\left(\sqrt{\frac{H}{6D}}\xi\right)\right]^2} = -\frac{36HD^2c_1^2}{G\left\{6Dc_1 - exp\left[\sqrt{\frac{H}{6D}}(x-vt)\right]\right\}^2}. \tag{13}$$

In the figures below we show the solution (13) of the equation (5), we have chosen values of the parameters:

$$D = 5, G = -10, H = 7; c_1 := -\frac{1}{10}.$$





Conclusion

In this paper, we discuss a model of partial differential equation for description of the spatio-temporal dynamics interacting agent systems. From a practical point of view Eq. (5) can be used for eventual prognosis and control, for example in the borders of a specific area. From statistical data sources estimations of the coefficients can be obtained. The most difficult task is the determination of the coefficients and, but they can be obtained by standard or appropriate statistical procedures as well. After determining the coefficients we can simulate Eq. (4) with known or appropriate initial conditions. On the other hand we can obtain some information about agent system in the considered regions without numerical solving the system of equations but on the basis of qualitative analysis of PDEs only. For the purpose here we discuss in more details simplest case of 2 equations. For this case, the model system is reduced to a single (1+1)-dimensional nonlinear PDE fourth order for which an exact analytical solution can be obtained. This equation describes the evolution of the spatial density. Solitary waves can travel through the system if the amplitude of such a density becomes large. In addition, by means of appropriate ansatz, we obtain an exact particular analytical solution of the model equation. This solution describes nonlinear kink and solitary wave, expressing the spreading of the density changes in the space.

Acknowledgements

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Mathematical Modeling of the Migration - Linear Approximation of the First Boundary Problem

Miroslava Ivanova[1], Denislav Serbezov[2], Milen Dimitrov[2]

[1]University of National and World Economy, Sofia, Bulgaria
mi_ka@abv.bg

[2]University of Chemical Technology and Metallurgy, Sofia, Bulgaria
serbezov7@gmail.com , grems@abv.bg

Abstract. Much of the complex economic and social systems contain elements that influence each other in competition or cooperation. With the growing complexity of this interaction, competing elements are beginning to adapt to environmental changes. In recent years, methods of nonlinear dynamics, chaos theory and time series analysis began to be used increasingly in the study of such adaptive systems. The main characteristics of complex systems can be understood on the basis of a relatively small number of autonomous differential equations in which the above methods of analysis are particularly suitable. In this paper we consider a summary of such systems of equations associated with the introduction of spatial density of individuals. In this way we can determine not only the number of individuals for the moment, but their spatial location.

Keywords. Complex systems, parabolic differential equations, social dynamics, migration human populations, interacting agents.

1. Introduction

In this paper we consider a mathematical model to describe the joint dispersion and growth phenomena. We allow the population to grow and disperse at the same time and are interested in of temporal and spatial behavior of the population in a general pattern of growth. We analyze the so-called diffusion-reaction systems where time and space depends on the function that describes the population at any location and time. The temporal change of the size of the population of point depends on both component of the diffusion, and the growth components. We will see that depending on the chosen model of growth would be very different population dynamics. The decision which describes the population of such partial differential equations is necessary to specify initial conditions. We assume that we they are only interested in the behavior of the population in the restricted area, and the lack of non-linear phenomena.

Much of the complex economic and social systems contain elements that influence each other through competition or cooperation [1-6]. If the number of agents and chaos in their behavior is small, it is possible to describe the system of interacting agents with more or less - less complicated systems of ordinary or partial differential equations. Such systems should describe the characteristic of the collective behavior of agents (their movement in space). We need just such modeling is required to describe the interactions between different social groups. Therefore, the deterministic model using the various kinds of systems, differential equations is widely spread further. For the case we are interested in pro and spatial detection should be available to individuals in the system of agents we need to use more partial

differential equations and systems [15-20, 24-28]. There are different methods for the preparation of a solution of these systems of equations. Some of them are obtained values of the solution corresponding to the specified time and space coordinates. In some cases, however, a good idea will give us the decision itself, although derived under appropriate assumptions about its type. Lately particularly interesting from a practical point of view, are the solutions obtained in the form of waves that describes the immigration of individuals in space, i.e. so-called population waves [7-11, 30-32]. The systems studied the dynamics of the population are some of the best examples of linear and nonlinear systems in quantitative social sciences [21-23, 33, 34]. Nonlinearities occur in the model equations for such is due to the interaction between individuals or populations, and limitations in the environment. Such nonlinear systems model requires the application of methods of nonlinear dynamics [4, 8, 12-14, 16], chaos theory and theory stochastic processes [13, 29]. Even though nonlinearity always present in the systems solutions of the linear system can give us some idea about the behavior of such systems, especially the case when the interaction is negligible or proceeds more slowly than the corresponding migration processes.

2. The Mathematical Model

Let us now we look at a system of interacting agents whose densities depend on time and coordinates in two-dimensional Euclidean space. The existence of spatial dimensions gives an opportunity to research migration. Mathematical model in the generally comprises a system of differential equations. Solving these equations allows us to better understand of migration in systems.

In the papers [2-5] Dimitrova and Vitanov have suggested a very general model of interacting agent systems:

$$\frac{dN_i}{dt} = r_i^0 N_i \left\{ 1 - \sum_{j=1}^{n} \left[\alpha_{ij}^0 - r_{ij} \right] N_j - \sum_{j=1}^{n} \sum_{k=1}^{n} \left[\alpha_{ijk} + r_{ij} \right] N_j N_k - \sum_{j=1}^{n} \sum_{k=1}^{n} \sum_{l=1}^{n} \alpha_{ij}^0 r_{ik} \alpha_{jlk} N_j N_k N_l \right\} \quad (1)$$

In these models, the parameter of state is the number of individuals in the population $N_i(t), i = 1,...,n$. Because we want to describe and spatial behavior of agents, we will take the parameter of the state spatial density of individuals:

$$\rho_i = \rho_i(x, y, t) = \frac{dN_i}{dS}, i = 1,..., n,$$

where dS is an infinitesimal around the studied point:

$$\frac{\partial \rho_i}{\partial t} + \Delta \rho_i = r_i^0 \rho_i \left\{ 1 - \sum_{j=1}^{n} \left[\alpha_{ij}^0 - r_{ij} \right] \rho_j - \sum_{j=1}^{n} \sum_{k=1}^{n} \left[\alpha_{ijk} + r_{ij} \right] \rho_j \rho_k - \sum_{j=1}^{n} \sum_{k=1}^{n} \sum_{l=1}^{n} \alpha_{ij}^0 r_{ik} \alpha_{jlk} \rho_j \rho_k \rho_l \right\}, \quad (2)$$

where $\Delta = \frac{\partial}{\partial x} + \frac{\partial}{\partial y}$.

For the case of one spatial dimension previous equation is of the form:

$$\frac{\partial \rho}{\partial t} - D \frac{\partial^2 \rho}{\partial x^2} = E\rho^4 + F\rho^3 + G\rho^2 + H\rho. \quad (3)$$

If we are only interested in small oscillations of the system around equilibrium, we can ignore the articles of ρ^4, ρ^3 and ρ^2. So we get a linear parabolic equation:

$$\frac{\partial \rho}{\partial t} - D \frac{\partial^2 \rho}{\partial x^2} = H\rho. \quad (4)$$

In the next section we will discuss the decision on the above equation in terms of the model in question.

3. First Boundary Problem

What we want to emphasize in this review is that linearity is related to the dispersion, resulting in a dilution of perturbation. In the case of migration waves, this means that with over time, the wave fades. For spread a wave of migration away from the area of the emergence need this wave to be nonlinear.

At this point, we will consider infinite system, which will have initial conditions:

$$\rho(x,0) = \rho_0(x), \tag{5}$$

where function ρ_0 fulfill the condition $H \leq 0$ (this condition is necessary to ensure the narrowness described decision). To not complicate too formulas, consider the case where interaction between the agents does not depend on the density ($\alpha_{111} = 0$).

Because $\rho_0 \neq 0$ and $\alpha_0 > 2/3\rho_0$ (we know that ρ_0 must where is greater than or equal to 0, because the density cannot be negative), we obtain the necessary condition for $H < 0$:

$$r_{11} > \frac{2\alpha_0+1}{\rho_0(3\alpha_0\rho_0-2)}. \tag{6}$$

Now, as we get to look and (5) initial condition we receive the decision of the equation (4):

$$\rho(x,t) = e^{Ht}\frac{1}{2\sqrt{\pi Dt}}\int_{-\infty}^{+\infty}\rho_0(\theta)e^{\left[-\frac{(x-\theta)^2}{4Dt}\right]}d\theta. \tag{7}$$

Now we will look at two specific cases of initial conditions. At first we have impulse interference with the small amplitude $\rho_0 = const$ of the underlying condition. Let $\rho_0(x) = \rho_0$ in the range $[x_1, x_2]$ and $\rho_0(x) = 0$ for other values to *x*. Denote by $\Phi(z)$ integral:

$$\Phi(z) = \frac{2}{\sqrt{\pi}}\int_0^z e^{-\theta}d\theta. \tag{8}$$

For this case we obtain the following solution:

$$\rho(x,t) = e^{Ht}\frac{\rho_0}{2\sqrt{\pi Dt}}\left[\Phi\left(\frac{x-x_1}{2\sqrt{Dt}}\right) - \Phi\left(\frac{x-x_2}{2\sqrt{Dt}}\right)\right]. \tag{9}$$

We can easily calculate the maximum decrease $\rho(x)|_{t=0}$, the initial impetus for large amounts of time *t*. the asymptotic behavior of the maximum height is:

$$\rho(x,t)|_{x=0} \approx \frac{\rho_0(x_2-x_1)}{2\sqrt{\pi Dt}}. \tag{10}$$

From the resulting solutions and asymptotic behavior we can conclude in the case of infinite size system starting small disturbance of the ground state of the system (caused for example by slightly increased birth rate in a given area) is dispersed and absorbed by the system.

4. Conclusion

In this article, we received the decision of the first boundary problem for linear model of the dynamics of the interaction of social systems taking into account the migration processes. So discussed in the previous section model can be applied in many other areas of sciences and technology. Note that the model summarizes many existing models ordinary differential equations.

For the above reasons described model promises for future research in economics and social sciences. For the above reasons described model promises for future research in economics and social sciences.

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Mathematical Modeling of Migration - Linear Approximation of the Second Boundary Problem

Veselin Boiadzhiev[1], Ivan S. Ivanov[1], Galina Koteva[2]

[1] University of National and World Economy, Sofia, Bulgaria
vesselinb@abv.bg, ivanov_i_s@abv.bg

[2]Department of Humanitarian Sciences, UCTM, Sofia, Bulgaria
kotevag@uctm.edu

Abstract. In this paper we consider a mathematical model to describe the joint dispersion and growth phenomena. We allow the population to grow and disperse at the same time and are interested in the temporal and spatial behavior of the population in a general pattern of growth. We analyze the so-called diffusion-reaction systems where time and space depend on the function that describes the population at any location and time. The temporal change in the size of the population of point depends on both component of the diffusion, and the growth components. We will see that depending on the chosen model of growth there would be very different population dynamics. The solution which describes the population of such partial differential equations is necessary to specify initial and boundary conditions. We assume that we are only interested in the behavior of the population in the restricted area, and the lack of non-linear phenomena. We set the initial state which determines the size of the population during t = 0 and domain issue first boundary condition on the boundary of the area concerned, which defines the behavior of the population on the border. In this case, we finally solve a boundary problem.

Keywords. Complex systems, partial differential equations, social dynamics, human populations, system of interacting agents.

1. Introduction

Much of the complex economic and social systems contain elements that influence each other through competition or cooperation. With the growing complexity of this interaction, competing elements are beginning to adapt to environmental changes. In recent years, methods of nonlinear dynamics, chaos theory and time series analysis began to be used more and more frequently in the study of such adaptive systems [7, 15, 17-25, 27-30]. The main features of complex systems can be understood on the basis of a relatively small number of autonomous differential equations in which the above methods of analysis are particularly suitable. Here we consider a summary of such systems of equations associated with the introduction of spatial density of individuals.

If the number of agents and chaos in their behavior is small, it is possible to describe the system of interacting agents with more or less complicated systems of ordinary or partial differential equations. Such systems should describe the characteristics of the collective behavior of agents (their movement in space). Such modeling is required to describe the interactions between different social groups. Therefore, in the deterministic model using the various kinds of systems, differential equations are widely spread further. For the case we are interested in, proper temporal and spatial detection should be available to individuals in the system of agents so that we need to use more partial differential equations and systems. There

are different methods for the preparation of a solution of these systems of equations. Some of them are obtained values of the solution corresponding to the specified time and space coordinates. In some cases, however, a good idea will give us the solution itself, although derived under appropriate assumptions about its type. Lately, particularly interesting from a practical point of view, are the solutions obtained in the form of waves that describe the immigration of individuals in space, i.e. the so-called population waves [8-12, 31-34]. The systems studying the dynamics of the population are some of the best examples of linear and nonlinear systems in quantitative social sciences [26, 35]. Nonlinearities occur in the model equations because they are due to the interaction between individuals or populations, and limitations in the environment [14, 25]. Such nonlinear systems model requires the application of methods of nonlinear dynamics [4, 8, 16] chaos theory [9,13,17] and theory stochastic processes [13,16,29]. Even though nonlinearity is always present in the systems solutions of the linear systems, it can give us some idea about the behavior of such systems, especially in the case when the interaction is negligible or proceeds more slowly than the corresponding migration processes. We will focus on the solutions of the linear equation placing suitably chosen boundary conditions.

2. Mathematical Model with Migration

Let us now look at a system of interacting agents whose densities depend on time and coordinates in two-dimensional Euclidean space. The existence of spatial dimensions gives an opportunity to research migration. Generally, a mathematical model comprises a system of differential equations. Solving these equations allows us to better understand migration in social systems.

In the articles [2-5] Dimitrova and Vitanov have suggested a very general model of interacting agent systems:

$$\frac{dN_i}{dt} = r_i^0 N_i \left\{ 1 - \sum_{j=1}^{n} \left[\alpha_{ij}^0 - r_{ij} \right] N_j - \sum_{j=1}^{n} \sum_{k=1}^{n} \left[\alpha_{ijk} + r_{ij} \right] N_j N_k - \sum_{j=1}^{n} \sum_{k=1}^{n} \sum_{l=1}^{n} \alpha_{ij}^0 r_{ik} \alpha_{jlk} N_j N_k N_l \right\} \quad (1)$$

In these models, the parameter of state is the number of individuals in the population $N_i(t), i = 1,...,n$. Because we want to describe and spatial behavior of agents, we will take the parameter of the state spatial density of individuals, i. e. $\rho_i = \rho_i(x, y, t) = \frac{dN_i}{dS}, i = 1,...,n$, where dS is an infinitesimal around the studied point:

$$\frac{\partial \rho_i}{\partial t} - \sum_{j=1}^{n} D_{i,j} \left(\frac{\partial^2 \rho_j}{\partial x^2} + \frac{\partial^2 \rho_j}{\partial y^2} \right) = r_i^0 \rho_i [1 - \sum_{j=1}^{n} \alpha_{ij}^0 \rho_i + \sum_{j=1}^{n} r_{ij} \rho_j - \sum_{j,k=1}^{n} (\alpha_{ijk}^0 + r_{ik}) \rho_j \rho_k - \sum_{j,k,l=1}^{n} \alpha_{ij}^0 r_{ik} \alpha_{ijl} \rho_j \rho_k \rho_l] \quad (2)$$

For the case of one spatial dimension, the previous equation is of the form:

$$\frac{\partial \rho}{\partial t} - D \frac{\partial^2 \rho}{\partial x^2} = E\rho^4 + F\rho^3 + G\rho^2 + H\rho. \quad (3)$$

If we are only interested in small oscillations of the system around equilibrium, we can ignore the articles of ρ^4, ρ^3 and ρ^2. So we get a linear parabolic equation:

$$\frac{\partial \rho}{\partial t} - D \frac{\partial^2 \rho}{\partial x^2} = H\rho. \quad (4)$$

In the next section we will discuss the solution of the above equation in terms of the model in question.

3. Second Boundary Problem

What we want to emphasize in this review is that linearity is related to the dispersion, resulting in a dilution of perturbation. In the case of migration waves, this means that with the time, the wave fades. For the spread of the wave of migration away from the area of the emergence, this wave has to be nonlinear.

At this point, we will consider the case for end system that will impose boundary conditions of the kind of impermeable borders. As initial condition we will take $\rho(x,0) = \rho_0(x)$, where the function ρ_0 fulfills the condition $H \leq 0$ (this condition is necessary to ensure the narrowness of the described solution). In order to not complicate the formulas, we will consider the case where the interaction between the agents does not depend on the density ($\alpha_{111} = 0$).

Let us now consider a system with finite size located between x = 0 and x = l. We will look at the type of boundary conditions

$$k\frac{\partial\rho}{\partial x}\Big|_{x=0} = h_0\rho\Big|_{x=0} \quad , k\frac{\partial\rho}{\partial x}\Big|_{x=l} = h_l\rho\Big|_{x=l} \quad , \tag{5}$$

where k, h_0 and h_l are positive constants, h_0 and h_l are characteristics of boundaries (as far as border crossing is difficulty), k is a characteristic of the system, located between the limits (as long as there are difficulties in passing which change the system). One part of the solution equation (4) is:

$$\rho(x,t) = e^{-\lambda^2 t}\left[\alpha\cos(\mu x) + \beta\sin(\mu x)\right], \tag{6}$$

where α, β, λ and μ are parameters, and $\lambda^2 = \mu^2$D-H. The solution satisfies the boundary conditions, if:

$$tg(\mu l) = \frac{k\mu(h_0 - h_l)}{k^2\mu^2 + h_0 h_l} \quad . \tag{7}$$

If the μ_n, n=0, 1, 2,…, n are solutions to the above equation, the general solution of the equation (4) will be the sum of the solutions (6):

$$\rho(x,t) = e^{(H - D\mu_n^2)t}\sum_{n=0}^{\infty}\beta_n\left[\frac{k}{h_0}\mu_n\cos(\mu_n x) + \sin(\mu_n x)\right] \quad . \tag{8}$$

The constants β we will be determined from the initial condition $\rho(x,0)=\rho_0(x)$. Let:

$$X_n(x) = \frac{k}{h_0}\mu_n\cos(\mu_n x) + \sin(\mu_n x) \quad I_n = \int_0^l X_n^2(x)dx \quad , \tag{9}$$

$$\beta_n = \frac{1}{I_n}\int_0^l \rho_0(x)X_n^2(x)dx$$

Then .

Let us now consider the case when the borders are impassable: $h_0 = h_l = 0$. Then for the equation μ_n for n=0, 1, 2,…, n we get $\mu_n l = n\pi$. Satisfaction of the initial and boundary conditions leads us to:

$$\rho(x,t) = \frac{2}{l} e^{Ht} \sum_{n=0}^{\infty} \cos\left(\frac{n\pi x}{l} \mu_n x\right) e^{-\frac{n\pi x}{l}} \int_0^l \rho_0(x) \cos\left(\frac{n\pi x}{l} \mu_n x\right) dx. \quad (10)$$

4. Conclusion

In this article, we received the solution of the second boundary problem for a linear model of the dynamics of interaction of social systems taking into account the migration processes. The model discussed in the previous section can be applied in many other areas of sciences and technology. It should be noted that the model summarizes many existing models of ordinary differential equations.

For the above reasons, the described model can also be used for future research in economics and social sciences.

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Quasi Steady-State Approximations of Dynamical Systems in Economy. A Special Case of Demographic Transition

Elena V. Nikolova[1], Ivan P. Jordanov[1,2]

[1] IMECH - BAS, Sofia, Bulgaria
e*lena@imbm.bas.bg*

[2] University of National and World Economy, Sofia, Bulgaria
i_jordanov@email.bg

Abstract. In this paper we discuss a Quasi-Steady-State Approximation (QSSA) methodology for reduction of dynamical systems with time hierarchy. We apply this methodology to a dynamical model, which represents a basic demographic transition process. The model expresses the influence of the Gross domestic product (GDP) of the countries on the children mortality and the total fertility rate in the countries. On the basis of previously published parameter values, the system of three ordinary differential equations is rewritten in a form suitable for model reduction. In accordance with the terminology of the QSSA theorem, it is established that the GDP of countries is 'fast varying', such that the corresponding equation form an attached system. The total fertility rate is 'medium varying' and the corresponding equation is degenerate with respect to the fast one. The children mortality is 'slow varying', and its equation together with the 'medium varying' equation form a degenerate system. It is proved that the interaction between the fertility rate and the children mortality can be considered as a driver of the quasi-stationary behaviour of the demographic process.

Keywords. Reduction of dynamical systems, different time scales, quasi-steady-state approximation, demographic transition.

1. Introduction

Mathematical modeling of dynamics of many economic and social processes is realized by high-dimensional systems of ODEs, because of its complexity [1-9]. Because of high dimensionality of these systems they can be investigated only by pure computational methods. In this aspect, there is not information for the qualitative behavior of such processes. Therefore the choice of an adequate methodology for reduction of dimensionality of ODE systems is very important. The main advantages of the QSSA methodology are: 1) By use of this methodology we can identify the fast and slow stages in the economic event; 2) This identification can help to determine the driving stages of the process, which are valid near to its stationary state; 3) The qualitative analysis of the reduced system (QSSA approximation) can give a basic tendency for control and management of the considered economic event.

This approach was used for investigations of biological and medical processes [10-14]. However, it can be applied to models, which represent dynamics of many economic events, such as catastrophes, business cycles, economic chaos, economic development and growth, where "fast" and "slow" stages can be identified.

The reminder of this paper is constructed as follows. In Section 2, the basic aspects of the QSSA methodology are presented. We apply this methodology to a dynamical system, which represents a demographic transition process in Section 3. Stability analysis of the

obtained QSSA approximation of the basic model is carried out in the same section. The main results derived from the investigation are summarized in Section 4.

2. QSSA Methodology

In the common case, the economic models with different time scales can be presented by dynamical system in the form:

$$\varepsilon \frac{dx_p}{dt} = f_p(x_1,.....,x_r,x_{r+1},.....,x_n), \quad p = 1,2,...,r \tag{2.1}$$

$$\frac{dx_q}{dt} = f_p(x_1,.....,x_r,x_{r+1},.....,x_n), \quad q = r+1,....,n, \tag{2.2}$$

where $x_p \in R^m, x_q \in R^n, 0 < \varepsilon << 1$. Furthermore, for such a system it is introduced the following terminology: The first part of equations, having ε in the numerator, is called an attached system, with respect to the other part of equations, which form a degenerate system. In this way, the variables of the attached system are called fast variables and these of the degenerate system are considered as slow ones. We stress that the methodology for separation of every system of ordinary differential equations to fast and slow subsystems (or to a system of kind (3.1)–(3.2)) is performed by appropriate scaling (normalization) of the system coefficients on the basis of well -known data of their numerical values. The proposed scaling procedure is similar to the dimensionless principle. It requires that each term in the right-hand side of the system equations to have one and the same order. The set of both systems form a complete system. In accordance with this terminology, the QSSA theorem [15] claims that:

The solution of the complete system (2.1-2) tends to the solution of the degenerate system (2.2) at $\varepsilon \to 0$, if the following conditions are satisfied:

a) There is an equilibrium (steady state) solution of the attached system, which is isolated one (i.e. there is not other solution in its neighborhood);

b) The existing equilibrium solution of the attached system is stable one for every value of the slow variables;

c) The initial conditions (states) lie in a region of influence (a basin) of the equilibrium solution of the attached system;

d) The solution of the complete system is single-valued and its right hand sides are continuous.

The essence of the QSSA theorem is that the character of the solution of (2.1-2) does not change when the small parameter ε converges to zero. Thus, we can assume $\varepsilon = 0$ in (2.1) and instead of differential equations obtain algebraic ones for the steady-state value of fast variables.

$$f_p(\varphi(x_q,t),t) = 0, \qquad x_p = \varphi(x_q,t) \tag{2.3}$$

$$\frac{dx_q}{dt} = f(\varphi(x_q,t),x_q,t) \quad q = r+1,.....,n \tag{2.4}$$

In principle the economic systems satisfy conditions a), c) and d) from the theorem. Thus, we stress our attention only on analysis of stability of the stationary solution of the attached system. In this way, the complete system (2.1-2) can be reduced to the degenerate system (2.4). For every fixed x_p, Eq. (2.4) has an unique solution that depends continuously on the slow variables x_q. Thus the variables x_q play the role of a driver of the subordinated

variables x_p. In accordance to the QSSA theorem, when the stationary solution of the attached system is isolated and stable, then the solution of the reduced (degenerate) system depends only on the post-initial values of the slow variables. The term 'post-initial' is introduced in sense of the considerations of initial and later intervals of validity of the complete and degenerate systems, respectively. Certainly, the complete system (2.1–2) holds any time, and the degenerate system (2.4) shall be valid from some later period of time.

3. QSSA Approximation of a Demographic Transition Model

We discuss a special case of the demographic transition model [16], which is presented in the form:

$$\begin{aligned} &\frac{dG}{dt} = \frac{a_1}{A} - a_2\frac{G}{A} - a_3\frac{1}{AG} \\ &\frac{dC}{dt} = -a_4 CG - a_5 C^2 \\ &\frac{dA}{dt} = -a_6 A - a_7 AC - a_8 A^2 + a_9 \end{aligned} \tag{3.1}$$

where G is log GDP (Gross domestic product), C the mortality indicator, which refers to the number of children not surviving to age 5 per 1,000 live births and is a strong indicator of child health, and A is a total fertility rate, which is the average number of children a woman has in the course of her lifetime. In [16] data were taken from the World Bank `World Development Indicators' dataset. It contains data for nearly 200 countries for a period of more than 50 years. For the economic indicator, the authors in [16] used the GDP per capita (in constant 2005 dollars) from the publicly available Gapminder dataset. The numerical values of the model coefficients in (3.1) are determined in [16]. They are:

$$\begin{aligned} &a_1 = 0.688,\ a_2 = 0.043,\ a_3 = 2.193,\ a_4 = 0.0045,\ a_5 = 0.000056, \\ &a_6 = 0.007,\ a_7 = 0.0000077,\ a_8 = 0.0063,\ a_9 = 0.091. \end{aligned} \tag{3.2}$$

Applying the QSSA methodology, we normalize the coefficients (3.2), introducing a small parameter q ε ($\varepsilon = 0.01$), as they are changed from 0.01 to 1. Then, the coefficients in (3.1) can be presented as:

$$\begin{aligned} &a_1 = b_1,\ \ a_2 = b_2, a_3 = b_3/\varepsilon, a_4 = \varepsilon b_4, a_5 = \varepsilon^2 b_5, \\ &a_6 = \varepsilon\ b_6,\ a_7 = \varepsilon^2 b_7, a_8 = \varepsilon b_8,\ a_9 = b_9, \end{aligned} \tag{3.3}$$

We substitute Eq. (3.3) in Eqs (3.1), and obtain:

$$\begin{aligned} &\varepsilon\frac{dx_1}{dt} = \frac{\varepsilon b_1}{x_3} - \varepsilon b_2\frac{x_1}{x_3} - \frac{b_3}{x_1 x_3} \\ &\frac{1}{\varepsilon}\frac{dx_2}{dt} = -b_4 x_1 x_2 - \varepsilon b_5 x_2^2 \\ &\frac{dx_3}{dt} = -\varepsilon\ b_6 x_3 - \varepsilon^2 b_7 x_2 x_3 - \varepsilon\ b_8 x_3^2 + b_9 \end{aligned} \tag{3.4}$$

According the QSSA methodology, the variable x_1 (G) appears to be a fast variable, while the variables x_2 (C) and x_3 (A) are slow variables. Moreover, x_3 is a medium varying factor compared with the variables x_1 and x_2. There are two possible equilibrium value of

x_1 and they are:

(3.5) $$x^0_{1(1)} = \frac{b_1 - \sqrt{b_1^2 - 4b_2b_3/\varepsilon}}{2b_2}, \quad x^0_{1(2)} = \frac{b_1 + \sqrt{b_1^2 - 4b_2b_3/\varepsilon}}{2b_2}$$

The lower value $x^0_{1(1)} = 4.4$ corresponds to the stationary GDP in developing countries, while the higher value $x^0_{1(2)} = 11.6$ corresponds to the stationary GDP in rich countries [20]. In order to examine the stability of the equilibrium states we consider small variations around them as $x_{1(1,2)} = y_{1(1,2)} + x^0_{1(1,2)}$. Then the linearized equation of the first equation of (3.1) has the form:

(3.6) $$\frac{dy_{1(1,2)}}{dt} = -\frac{b_2}{x_3} y_{1(1,2)}$$

Because x_3 is a slow variable, it is assumed to be constant in (3.6) in view of the fact that it remains unchanged in the period when the fast variable x_1 is changed. The variation $y_{1(1,2)}$ evidently tends asymptotically to zero. Thus the equilibrium points (3.5) are stable. Following the QSSA algorithm we substitute them in the second equation of (3.1). Then the quasi-stationary approximation of the system (3.1) in an original form (after introduction of the reverse substitutions) can be presented as:

(3.7) $$\frac{dC}{dt} = -a_{4(1,2)}C - a_5C^2$$
$$\frac{dA}{dt} = -a_6A - a_7AC - a_8A^2 + a_9$$

where for the developing countries $a_{4(1)} = a_4 \frac{a_1 - \sqrt{a_1^2 - 4a_2a_3}}{2a_2}$, and for the rich countries $a_{4(2)} = a_4 \frac{a_1 + \sqrt{a_1^2 - 4a_2a_3}}{2a_2}$. Next we have to concretize what type of dynamical behavior is realized by the two-dimensional system (3.7). We introduce small variations around the stationary values of the system variables, i.e. $C = y_2 + C^0$ and $A = y_3 + A^0$. Then the characteristic equation is:

(3.8) $$\begin{bmatrix} -(a_{4(1,2)} + 2a_5C^0) - \lambda & 0 \\ -a_7A^0 & -(a_6 + a_7C^0 + 2a_8A^0) - \lambda \end{bmatrix} = 0$$ or

(3.9) $$\lambda^2 + p\lambda + q = 0$$

where

(3.10) $$p = a_{4(1,2)} + a_6 + (2a_5 + a_7)C^0 + 2a_8A^0 > 0$$
$$q = (a_{4(1,2)} + 2a_5C^0)(a_6 + a_7C^0 + 2a_8A^0) > 0$$

are the Routh–Hurwitz coefficients. As is well known from the standard theory these values correspond to phase plot of a strongly damped linear oscillator (damper). That is the behavior of (3.7) is stable. In this way the quasi-stationary behavior of the complete model (3.1) is stable too. Thus the interaction between the fertility rate and the children mortality could play the role of a *driver* of the whole demographic process near to its quasi-stationary state.

4. Conclusion

The general investigation carried out in this paper is focused on the reduction of dimensionality of a dynamical model of demographic transition. This aim is achieved by applying the QSSA methodology. Analysis of the obtained quasi-stationary system shows that the GDP of the countries influences only in the beginning of the demographic transition. When the process, however, approaches near the quasi-stationary state this influence ceases. Then its dynamical behaviour becomes stable and is driven only by the interaction between the fertility rate and the children mortality.

Acknowledgment

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Application of International Standards for Risk Management in SMES

Nedyalko Ivanov

ISER - BAS, Sofia, Bulgaria
ivanov.ni@abv.bg

Abstract. This publication gives an idea of the possibilities for the cumulative application of the main international standards in risk management for small and medium-sized enterprises. The unification of the European standards EN ISO 9001: 2015, EN ISO 14001: 2005, EN ISO 18001: 2004, EN ISO 31000: 2009 and in any case EN ISO 17025: 2001 creates an integrated system for the proper operation of the enterprise.

Keywords. Risk management, **E**nvironmental risk, Health and safety management.

1. Introduction

The International Standards Organization (ISO) has the function to develop and disseminate the international standards in various areas. It is well known that international standards are voluntary for implementation and carry the best practices in the field of standardization.

International standards dealing with the management of all departments in the enterprise are designed to provide organizations with the essential elements of an effective management system in such a way as to comply with the relevant legislative requirements. These elements can be integrated with other management requirements in order to help organizations achieve their objectives in their proper functioning. These standards, as well as other international standards, are not intended to be used to create non-tariff barriers to trade or to increase or change the legal obligations of an organization.

2. Standards used in risk management

The main standards most commonly certified in the enterprise are: EN ISO 9001: 20015, EN ISO 14001: 2005, EN ISO 18001: 2004. In companies with more specific activities, such as testing laboratories are certified EN ISO17025: 2001 as well. A non-certified standard is EN ISO 31000: 2009, which can unify the above-mentioned standards.

2.1. International Standard EN ISO 9001: 2015 "Management systems for Quality"

International Standard EN ISO 9001: 2015 "Management systems for Quality" provide guidance to create an approach for the development, deployment, and improvement of the quality management system of the service or the end product, thus aiming to meet the requirements of the customers. Implementing and improving the efficiency of the quality management system is designed to increase customer satisfaction by meeting their requirements. For the efficient functioning of an organization, it is necessary to identify and manage multiple interrelated activities. Any activity or set of activities that uses resources and

is managed in such a way to make it possible to convert inputs into output elements, can be considered as a process. Often the input elements of a process are input elements for the next process.

This international standard can be used both within the organization and external parties, including by certification bodies, to assess the ability of the organization to meet customer requirements, the applicable requirements of regulatory acts created by a legislative body or by Another empowered authority, and the requirements of the organization itself.

A standard model of the standard is shown in Figure 1, expressing the circle of continuous improvement of the quality system and its ultimate dimension - customer satisfaction [1].

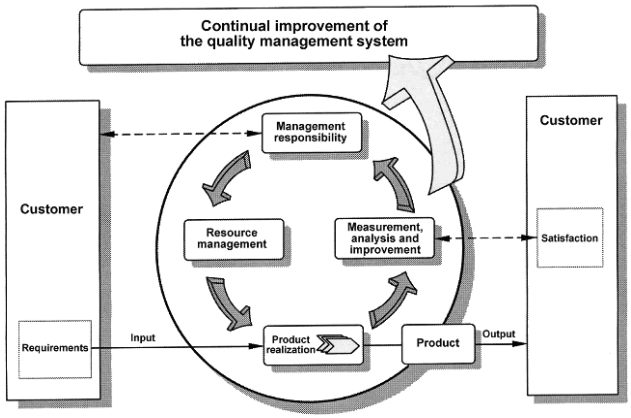

Fig 1. Model of quality management system

The model shows that to meet the customer's request it is necessary to observe and to monitor the procedures because in such way it is possible to receive higher quality product or service.

2.2. International Standard EN ISO 14001: 2005 "Environmental management systems. Requirements and instructions for application"

International Standard EN ISO 14001: 2005 "Environmental management systems. Requirements and instructions for application. ", helps company to initiate and to apply policy and overall objectives, taking into account legal requirements and information about significant environmental aspects.

This International Standard defines the requirements to an environmental management system to allow the organization to implement and apply policies and common objectives while taking into account the legal requirements and information on significant environmental aspects. It is intended to be applicable to organizations of all kinds and sizes and is adapted to different geographical, cultural and social conditions. The success of this system depends on the engagement of all levels and functions in the organization and especially its senior management. A system of this kind enables an organization to develop an environmental policy, to define the common goals and processes to meet policy commitments, to undertake an action for the improvement of its performance, and to show system compliance with the requirements of this international standard. The overall objective of this International Standard is to contribute to the protection of the environment and the prevention of pollution in a balance

with socio-economic needs. It should be noted that many of the requirements can be applied concurrently or reviewed at any time.

The implementation of the environmental management system is one of the important tasks of the enterprise for its proper functioning and compliance with environmental legislation. The principle model is presented on Figure 2 [2, 10].

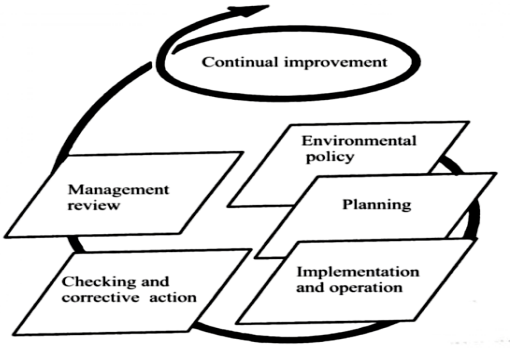

Fig.2. Model of an environmental management system

The continuous improvement process required by ISO 14001: 2005 is based on the cyclical methodology known as "Planning", "Implementation", "Verification" and "Action". This cycle can be briefly described as follows:

Planning - Defining the overall objectives and processes required to achieve results in accordance with the organization's environmental policy.

Execution - Implementation of processes.

Verification - Monitoring and measurement of environmental policy processes, general and specific objectives, legal and other requirements and reporting of results.

Action - Take action to continually improve the effectiveness of the environmental management system.

Figure 3 presents the improvement cycle [11].

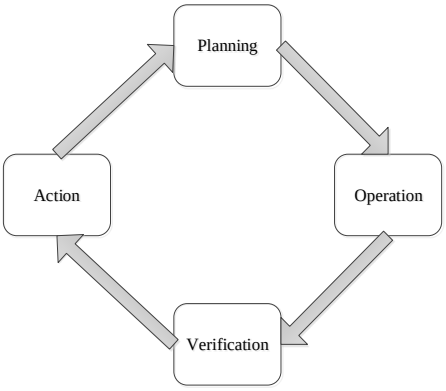

Fig. 3. Cycle Improvement

Compliance with the procedures and the cyclicality of both models leads to reducing the risk of negative impact on the environment.

2.3. International Standard EN ISO 18001: 2004 "Health and safety at work. Requirements"

International Standard EN ISO 18001: 2004 "Health and safety at work. Requirements". This standard covers OH & S management and aims to give the organization the elements of an effective OH & S management system that can be integrated into other management systems and help achievement of economic and OH & S goals.

This OHSAS standard sets out OH & S management system requirements to enable the organization to develop and implement policies and targets that take into account legal obligations and information on OH & S risks.

It is intended for all types of organizations and aims to unite the diverse geographic, cultural and social conditions. The success of the system depends on the engagement of the organization at all levels and functional positions and, especially, by the organization's main leadership. This type of system enables the organization to develop OH & S policy to set goals and processes to achieve engagement policy, to take the necessary action to improve its manifestation and to demonstrate compliance of the system with the OHSAS standard. On the whole purpose of this standard is to support and present the best OH & S practices in accordance with the socio-economic needs. The implementation of the system leads to a reduction of labor incidents in the enterprise as well as to the prevention of future incidents. The principle model is presented in Figure 4 [4, 10].

Compliance with the procedures and the cyclicality of this standard leads to a reduction of minor accidents and fatal events.

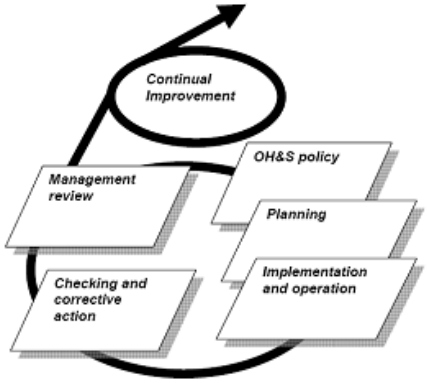

Fig. 4. Model OH & S Management System.

2.4. International Standard EN ISO 17025: 2001 "General Requirements for the Competence of Testing and Calibration Laboratories"

International Standard EN ISO 17025: 2001 "General Requirements for the Competence of Testing and Calibration Laboratories". This standard specifies the general requirements for competence in testing and / or calibration, including sampling. It refers to testing and calibration performed using standardized methods, non-standardized methods and methods developed by laboratories. This International Standard is applicable to all organizations that perform tests and/or calibrations. For example, first-, second- and third-party laboratories, as well as laboratories where tests and/or calibrations are part of the control and certification of products.

This International Standard is intended to be used by laboratories that set up their own quality management system and administrative and technical activities. It can also be used by customers of laboratories, by the authorized disposal authorities and by accreditation bodies, that confirm or recognize the competence of laboratories [3].

Figure 5 presents a master model of the EN ISO 17025: 2001 management system.

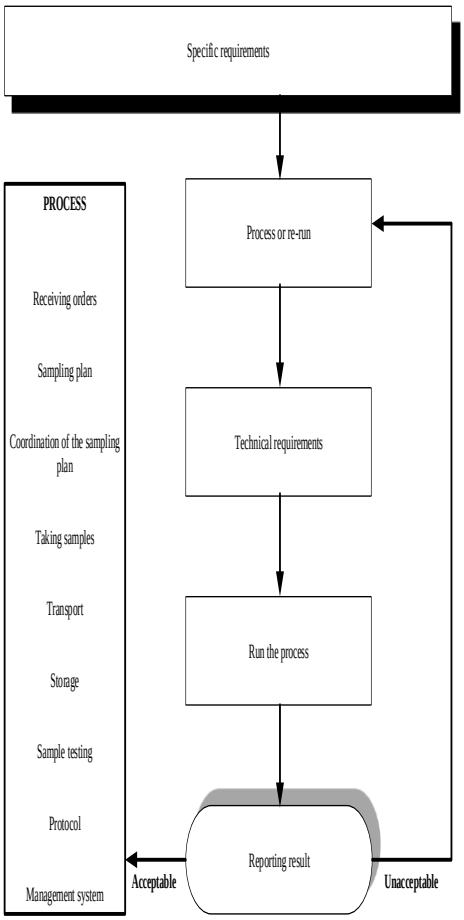

Fig. 5. Model of the management system of EN ISO 17025: 2001.

According to this standard, compliance with procedures results in more accurate results when analyzing environmental samples, thereby improving the assessment of small and medium-sized enterprises.

2.5. International Standard EN ISO 31000: 2009 "Risk management - Principles and guidelines"

International Standard EN ISO 31000: 2009 "Risk management - Principles and guidelines". The International Standard EN ISO 31000: 2009 defines the general principles and guidelines for risk management. It is applicable from organizations of all types and structure. The standard is applicable to any type of risk, regardless of its nature, its positive or

negative consequences. The EN ISO 31010: 2009 "Risk Management. Methods of risk assessment" standard is also included in the international standards series [6, 8]. It selects the most appropriate method for risk assessment. The EN ISO 31000: 2009 series of standards contain risk assessment methods.

Methods are divided into two groups: expert and probable. The expert methods are based on expert judgment through computational interpolation. The probability methods are based on graphical models, by suppositions of occurrence of the object of the survey object. The principal block diagram of the EN ISO 31000: 2009 series of standards is presented in Figure 6 [5, 7].

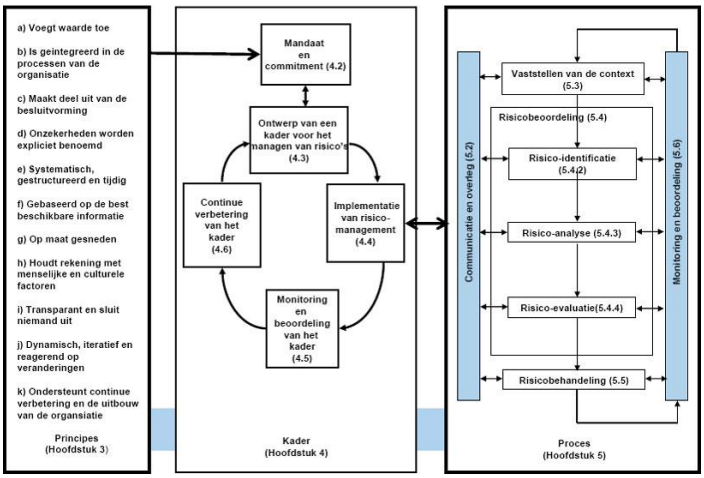

Fig.6. Schematic diagram of standard EN ISO 31000: 2009.

The choice of a suitable method is an important approach to risk assessment. Depending on the problem and the direction of the enterprise, it is necessary to choose the most appropriate method, which, depending on the outcome, will present the way to influence the risk.

3. Summaries of European Standards EN ISO 9001: 2015, EN ISO 14001: 2005, EN ISO 18001: 2004, EN ISO 17025: 2001, EN ISO 31000: 2009

Applying several basic standards in managing an enterprise leads to good practice for integrated business management, regardless of its business orientation.

Integrating more than one management system improves the overall performance of small and medium-sized businesses. Integrating more than one management system improves the overall performance of small and medium-sized businesses. Management systems as integrated systems for environmental management and control systems of health and safety at work, lead to an improvement of the general status of the enterprise.

EN ISO 17025: 2001 corresponds more closely to environmental management systems, the common one being that in most cases, environmental management systems require testing by companies holding a certificate of competence in testing laboratories. Due to this fact, this standard is a little more specific and can not be integrated into all enterprises.

EN ISO 9001: 2015 is the basic standard on the basis of which a number of other standards are built. It provides the general framework for deploying other systems.

Figure 7 shows a scheme of correspondence between standards and their combination.

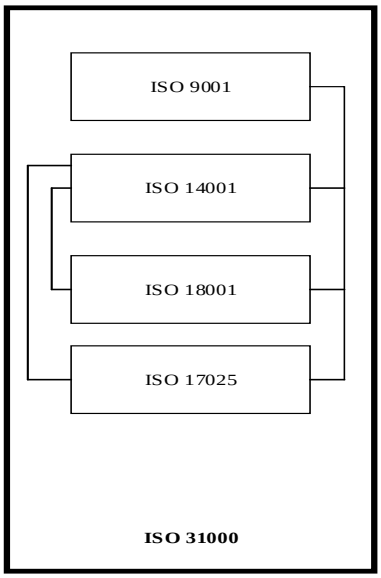

Fig.7. Scheme of correspondence between the standards EN ISO 9001: 2015, EN ISO 14001: 2005, EN ISO 18001: 2004, EN ISO 17025: 2001, differentiated in EN ISO 31000: 2009

Figure 7 shows the possibility of complementing standards, conducting a comprehensive risk assessment and managing it. It shows the overlap of the different standards.

The International Standard EN ISO 9001: 2015 is the foundation of EN ISO 14001: 2005 EN ISO, 18001: 2004 EN ISO 17025: 2001. The procedures developed in these standards are identical to the EN ISO 9001: 2015 procedures integrated with the scope of the specific standard.

The international standard EN ISO 31000: 2009 is applicable, in addition to all basic standards, it can be a framework for unification of standards EN ISO9001, EN ISO14001: 2005, EN ISO18001: 2007, EN ISO17025: 2005, by the methods for Risk assessment.

The methods of the series of standards for risk management can successfully implement systems for quality management systems, environmental management and management systems for safety at work. This integration facilitates the governance and management of enterprise systems management.

In the EN ISO 31000: 2009 series of standards, risk assessment methods are developed that can be applied to different standards. The tree of failure and event tree methods are appropriate for risk assessment under international standard EN ISO 18001: 2007 Environmental Management Systems.

HAZOP and toxicity assessment methods are methods that can be successfully used for risk analysis under EN ISO 14001: 2005.

Conditionally, Figure 7 illustrates its comprehensiveness and applicability to any other management system.

3. Conclusion

By summarizing several major standards, an analysis has been made of the need to deploy more than one management system. The implementation of the three main EN ISO 9001: 2015, EN ISO 14001: 2005, EN ISO 14001: 2005, EN ISO 18001: 2004 standards improves the overall quality of the product or service, while ensuring that the work and the environment are maintained in a way that complies with the normative acts.

This standard is a specific standard requirements for testing laboratories, and is applicable in specific companies, but is a system related to EN ISO 14001: 2005, having a major role in proper functioning and functioning.

Series of standards EN ISO 31000: 2009 is a series of risk management, this standard is not certified. It is applicable in all systems of government, it is a standard that provides guidelines and methodologies for determining the level of risk. Implementation of this standard in any system provides expert judgment on the level of risk, its prevention or reduction.

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Flat or Progressive Income Tax - Microsimulation Euromod Results

Ekaterina Tosheva[1], Dragomir Draganov[2]

University of National and World Economy, Sofia, Bulgaria
ekaterina_tosheva@yahoo.com

[2] ISSK – BAS, Sofia, Bulgaria
dragomir.k.draganov@gmail.com

Abstract. In this report is studied the impact of hypothetical changes in the of personal income taxation on household incomes in Bulgaria in 2015. Studied are three scenarios for change, whose impact on the basic parameters characterizing the distribution of household income is compared with the taxation legislation at the beginning of 2015. The consequences of these scenarios are simulated and evaluated by means of the tax-insurance transfer microsimulation EUROMOD model. The scenarios are also analysed through the prism of their estimated impact on tax revenues. On the basis of the obtained results are defined areas for future research on the topic.

Keywords. Income distribution, inequalities, poverty, personal income taxation, flat tax, progressive taxation.

1. Introduction

In 2008 Bulgaria implemented radical reforms in the system of personal income taxation. The model of progressive taxation was replaced with a model of proportional taxation with tax rate of 10% and no tax-free minimum (the so-called "flat tax"). Since its introduction, the "flat tax" has provoked intense discussions not only within the framework of the political, but also in the academic community. Its supporters claim that its introduction has actually led to higher tax revenue collection, reduced the informal economy, and promoted economic activity. On the other hand, advocates of progressive taxation models point out that the "flat tax" has reduced the tax burden for the highest income groups and increased it for the lower income groups, which has actually led to an increase, rather than a decrease in tax revenues. In this way, the ability of the state to influence income distribution has also been weakened and eventually this led to deeper income inequalities. However, despite the active public debate, so far there has not yet been a complete analysis of the direct consequences and the economic, fiscal, and social impacts of the change in the tax system.

Taking into account these circumstances, this report tries to contribute to this discussion, presenting empirical evidence for one part of the consequences which can be expected when replacing the proportional with progressive taxation.

It is important to stress that this report does not aim to clarify all issues relevant to discussions on "flat tax". Therefore, the research questions to be answered are limited to two:

(1) First, how would the main parameter values of household income distribution change, if the proportional personal income taxation was replaced with progressive taxation?

(2) Second, in case of such a change, how would the average amount of tax obligation – total and by households income groups change?

The analysis gives grounds to be concluded that, in contrast to the widespread expectations, the introduction of more progressive model of personal income taxation does not automatically lead to a reduction in inequalities and poverty, nor to a more equitable distribution of the tax burden among the various income household groups. Also, ideologically motivated changes to the system of income taxation for individuals which are not coordinated with the actual parameters of the household income distribution are much more likely to lead to consequences which radically contradict the publicly announced ones.

2. Models of taxation and inequalities – international and national dimensions of the debate

Inequality in household income distribution in developed market economies is influenced primarily by two sets of factors. On the one hand, the level of inequality in the distribution of market income and, on the other hand, the way in which the state, through tax and social security systems and social protection systems, affect its redistribution. In a recent research, the Organisation for economic cooperation and development (OECD) showed that tax and social security systems everywhere lead to a reduction of inequalities in market income. On average for the OECD, about one-third of the decrease is due to the taxes, and the remaining two-thirds – due to social transfers [1]. This shows that regardless of their design, the tax systems in the most economically developed countries do not have as much influence on reducing inequalities in income distribution, as social transfers.

From a theoretical point of view it is assumed that in comparison to the other taxes, income taxes have the strongest influence on the decisions of economic agents, because of which, at least from economic point of view, tax reforms should aim to shift the burden to other types of taxes, such as indirect taxes or immovable property taxes [2].

The concept of the so-called "flat tax" is largely based on the presented assumptions with regard to income taxation. It is considered to have been developed by the American economists Robert Hall and Alvin Rabushka. According to them, the "flat tax", representing a rate applied to all income above a certain amount, is the tool by which to implement the basic principle of any tax reform, namely "limiting the tax burden on the poor." At the same time, such a taxation model would stimulate economic development, promote economic activity and supply of labour force, as well as household savings [3]. It is important to note that Hal and Rabushka are aware that their proposal will mostly benefit the highest income groups, but in their opinion, this is the way through which, in the long term, better welfare for all is to be achieved. Lower marginal tax rates for higher income households will stimulate both consumption and savings, and consequently - investments and economic growth.

As to the progressive income tax, generally it may be presented as a model in which tax increases with increase in taxable income. Progressive taxation relies on the so-called "ability-to-pay principle", according to which those who have higher incomes, have to pay higher taxes. It is believed that higher equity in the distribution of tax burdens is achieved this way. At the same time, a number of influential scholars tend to assume that the weakening role of that principle in the formulation of tax reforms in developed market economies has to do with growing income inequalities. On the basis of data for the United Kingdom for the past century, the famous British economist Anthony Atkinson shows that policies to reduce the progression of tax systems actually have led to increasing the share of income held by the people with the highest incomes, of the total income. Similar correlations are observed in other countries (United States, Canada, Norway, Ireland, Italy, New Zealand, Australia, etc.). In the past four decades, in countries where there has been the greatest tax rate reduction for the highest income groups, the share of their income in the total income has grown most

significantly. Therefore, Atkinson sees the tax rate increase for the highest income groups as a way to reduce inequality on a macro level [4].

In Bulgaria, the debate regarding the impact of the imposed by the reform in 2008 personal income taxation model often is in its two extremes – from complete denial of the "flat tax" to presenting it as the best possible taxation model in terms of economic and social development. Opponents of the "flat tax" claim that the reform is a political failure, indicating that it was imposed in a non-democratic manner, with the leading role of the so-called "think-tanks" and without a broad public debate [5]. Other authors attack the ideological foundations of the reform, describing it as part of the so-called "neoliberal agenda", at the same time criticizing the relevance of the model to the specific economic conditions. On the other hand, supporters of the reform argue that immediately after the introduction of the "flat tax", it lead to higher tax revenues, higher level of employment, lower levels of unemployment and higher disposable incomes [7].

From this perspective, it can be seen that in terms of content the discussions in Bulgaria do not differ notably from the dominant in the theory and practice political debates on income taxation. They are distinguished with sharply expressed conceptual contradictions and, to a lesser extent, with empirical evidence, clearly and unambiguously demonstrating the causal link between the supported taxation model and related effects.

3. Evaluation of changes in certain elements of the personal income taxation model in Bulgaria: method and data

To answer the research questions are simulated three hypothetical scenarios for changes in the taxation model. They, along with the baseline scenario, are presented in the following table:

Table 1. Baseline and Hypothetical Scenarios

Scenario	Monthly Tax Bases and TAX Scheduels
Baseline scenario	10% of the final consolidated tax base, without a tax-free minimum ,
Scenario1	from 0 to 410 BGN – 0% Up to 410 BGN –17% for incomes higher than 410 BGN
Scenario 2	0 – 370 BGN - 0% 370 BGN - 1000 BGN. – 10% for incomes higher than 370 BGN 1000 - 2000BGN – 15% for incomes higher than 1 000 BGN., plus 63 BGN. 2000 - 5000 BGN – 20% for incomes higher than 2 000 BGN, plus 213 BGN 5000 - 10000 BGN – 25% for incomes higher than 5 000 BGN, plus 813 BGN More than 10000 BGN – 27% for incomes higher than 10 000 лв., plus 2 063 BGN
Scenario 3	0 - 400 BGN – 0% 400 - 600 BGN – 20% for incomes higher than 400 BGN 600 лв. -1200 лв. – 22% for incomes higher than 600 BGN, plus 40 BGN More than 1200 BGN – 24% for incomes higher than 1200 BGN, plus172 BGN

Two of the scenarios (the first and the second) are formulated on the basis of real suggestions by politicians, made in the course of the discussions regarding income taxation. The first scenario is an adapted version of the proposal by the Union of Democratic Forces (center-right party) for the of personal income taxation model, announced publicly in 2006 as part of the debate on the Bill on State Budget for 2007, i.e. before the reform of 2008 [8]. The second scenario is part of the proposal for the reform by the parliamentary group of the Bulgarian Socialist Party - left Bulgaria (coalition of parties in the left spectrum of the political space), submitted in the form of a bill amending and supplementing the law on personal income tax in 2016 [9]. The third scenario represents an experimental balanced version of both proposals.

For each scenario, the direct consequences are evaluated on some main parameters characterizing household income distribution. These are:

- *Poverty Level* – in total and by groups, measured as a proportion of the population living in households with disposable income equivalent to income under the poverty line of 60% of median disposable income;

- *Inequality Level* – measured by the Gini coefficient;

- *Size and share of disposable income of the total income* – total, for poor households and by decile groups;

- *Size and share of the tax obligation of disposable income* – total, for poor households and by decile groups.

At the next stage, the results for each scenario are compared with the parameters of income distribution in the so-called 'baseline scenario', reflecting the current situation. Direct effects for each of the scenarios, including the base scenario, are simulated using the Bulgarian module in the EUROMOD model – the pan-European microsimulation model for analysis of tax-transfer intervention on household income in the EU countries. Integrating tax and social security and transfer policies, characteristics of households and their material condition, EUROMOD allows to correctly assess the direct effects of the policies on household income distribution, poverty and inequality [10], as well as the so-called "budget neutral" reforms [11]. A more detailed description of the Bulgarian module in the EUROMOD model, as well as the specificities and the restrictive conditions of microsimulations are presented in [12] and [13].

For the purposes of this report, assessment are done using the model version with data from a nationally representative sample of Bulgarian households from a monitoring of the income and living conditions (EU-SILC) in 2014. On the basis of the data for 2014 and changes in tax and social security and transfer policies, their consequences are possible to be simulated for future periods of time.

Using this advantage of the EUROMOD model, this report gives an answer to the question: what changes in the income distribution and in the tax obligations amount would have occurred, i.e. what would have been the situation in 2015, if instead of proportional taxation, personal income had been taxed using a progressive model.

The EUROMOD model has some limitations which should be considered in the analysis and interpretation of the results. First of all, because of the limited information in the EU-SILC for some incomes, benefits and allowances, the latter are either not simulated, or are simulated only partially. In this case, the actual data is used, indexed with the appropriate coefficients (for example, the consumer price index, etc.).

Secondly, when comparing the indicators obtained by microsimulations with EUROMOD to analogue estimates derived directly from data from the EU-SILC survey, there are certain differences. They are due primarily to the incomplete coverage of the used definitions of key concepts and the fact that the units that are not consistent with one or more basic attributes are excluded from the EUROMOD analysis. In the microsimulations of each unit are "attributed" accruing taxes and benefits, not taking into account their actual receipt or disbursement. [11]

Thirdly, the EUROMOD is a "static" microsimulation model, therefore it cannot evaluate and analyse possible behavioral effects of households, related, for example to participation in the labour market or the informal economy, which are extremely complex for modeling and often have a high degree of uncertainty. Taking into account the substantial impact that changes in tax systems have on the decisions of economic actors, the results of the EUROMOD simulations should not be regarded as identical to the medium-term or long-term effects of relevant policies.

4. Results data

The starting point of the comparative analysis of the results of the simulated scenarios is the comparison of the relative shares - total and by groups of population living in households below the poverty line and Gini coefficients, assessed on the basis of disposable income (all social transfers, including pensions from the system of compulsory social insurance, and deducted taxes and paid insurance are added to the original income). The relative share of the poor is estimated for the following specific groups – children (18-year-old or younger persons), persons of working age (from 19 to 64 years of age inclusive), elders (persons 65 years and over) and economically active persons (persons in the economically active age who are employed or self-employed). The results are presented in Table 1.

The estimated poverty line in the four scenarios is different. In the base scenario, and scenario 3 it has similar values around 362 leva and in scenarios 1 and 2 it is respectively 378.7 BGN and 376.1 BGN Regarding this, the comparisons below are relative in nature and concern primarily the inequality among the population, and not the absolute amount of disposable income.

When compared, the estimated Gini coefficient expectedly has lower values in the scenarios with a progressive scale of income tax. Interesting is the fact that in scenario 3, where intervals of incomes are narrower and the tax rate is growing more steadily compared to the proposed intervals and rates in scenario 2, the Gini coefficient is one point lower. In the base scenario and scenario 1 the values of this factor are very close.

When comparing indicators of poverty totally and by specific groups the following major differences can be highlighted. First of all, the lowest indicators of poverty are in scenario 3, both totally and for all groups. Compared with scenarios 2 and 3 together, for children and for persons of working age the difference is close to 1 point, but for adults it is about 3 points.

Table 2. Poverty and Inequality Levels after Different Scenarios

Indicators	**Baseline Scenario**	**Scenario 1**	**Scenario 2**	**Scenario 3**
Poverty Line (BGN)	**362.31**	**378.70**	**376.11**	**361.94**
Share of Poor%				
Total	21.15%	21.74%	21.64%	20.37%
Children	27.85%	27.90%	27.91%	26.91%
Working Age	17.62%	17.70%	17.68%	16.76%
Working Aged Economically Active	11.62%	11.35%	11.38%	10.75%
Elderly	26.70%	29.38%	28.92%	26.29%
Inequality in the Disposable Income Distribution				
Gini Coefficient	0.3388	0.3372	0.3234	0.3132

Of interest is the comparison of the simulated monthly average disposable household income in total and for the poor under the four scenarios, as well as the monthly amount of the taxes paid. The results are presented in Figure 1 and Figure 2. The lowest average disposable income is simulated in scenario 3 (1187 BGN), while at the same time the amount of taxes paid is highest (135 BGN). In the baseline scenario, and scenario 2 the average disposable income is very close, as well as the amount of tax paid. The introduction of the tax-free

minimum (according to scenario 2) reflects on the highest average income, but also on the lowest paid taxes, which would not reflect favorably on tax revenues. Interesting are the obtained results relating to the poor – both with the introduction of tax-free minimum and under a progressive tax rate with more intervals and larger differences in tax rate between income groups, there are no particular differences in the average income and tax obligations in comparison to the base scenario. In the base scenario (without a tax-free minimum) and scenario 3 (with a tax-free minimum) there are not any particular differences in the average disposable income of the poor, but in scenario 3, the average amount of taxes paid is 2.5 times less. This can be explained by the presence of low average tax rate for incomes at the bottom of the income distribution in comparison with the base scenario – for example, in the version with "flat tax", the effective tax rate for income under 600 BGN is 10%, whereas in scenario 3 it is 6.7%.

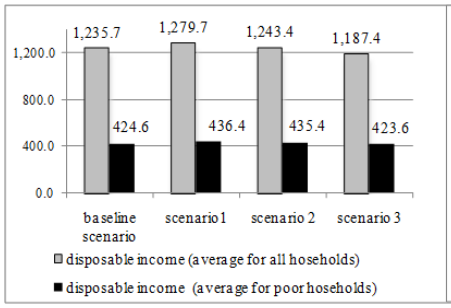

Fig. 1

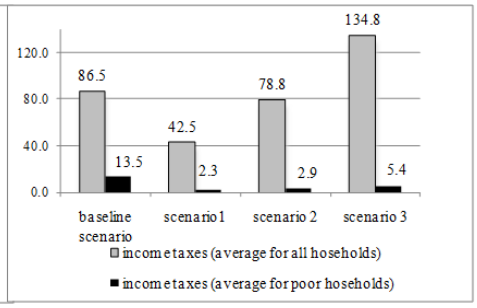

Fig. 2

To assess the direct consequences of the simulated scenarios for personal income tax on inequality and poverty it is essential to analyze the differences by decile groups. As pointed above, here again the comparison is in terms of decile groups, considering that in the lower and upper limit of the households income in the different decile groups there are some variations in the different scenarios. Estimates of the market and disposable income by decile groups are presented in Table No 3.

In the first decile group there are no differences in the average disposable household income. The lack of impact of the tax regime is due to the fact that perhaps a small portion of income in this group is from labour and assimilated to them relationships and different variations of taxation does not substantially reflect on them. The lack of a tax-free minimum in the baseline scenario has an effect on the average disposable income in the second group and it is around 10 BGN lower compared to the other three scenarios. The low tax rate of 10% on income from 370 to 1000 BGN according to scenario 2 and the tax rate of 17% for income over 410 BGN according to scenario 1 affect similarly the income in third, fourth and fifth decile and the average income in these groups according to the two scenarios is the highest.

The lack of a progressive increase in the tax rate in scenario 1 and the tax-free minimum reflects in the highest disposable household income from the sixth to the tenth decile compared to other scenarios. The comparison of the baseline scenario with scenario 2 shows that in all decile groups, with the exception of the tenth decile, the average income is higher. This result is quite expected, since in the scenario 2 high tax rates of 20% and more are proposed for incomes over 2000 BGN The experimental scenario 3 shows that the average disposable household income in the seventh, eighth, ninth and tenth decile is lower in comparison to the one in the base scenario. This practically means that the implementation of such a model of taxation will affect at least 40% of households by reducing disposable income.

In addition to changes in the average income total and by decile groups it is also

important to highlight the results of the simulation of various scenarios for income tax and on the average amount of taxes for the various decile groups (Table 4). The tax-free minimum of 410 BGN and proportional rate of 17% on all incomes above that minimum according to scenario 1 affect all decile groups in a similar way. For all groups is observed a reduction in the average amount of tax obligations. As an absolute amount the reduction is the lowest in the first decile group (10.9 BGN) and highest in the final one (77.8 BGN). However, as a relative amount in the first decile group the reduction is close to 90%, gradually decreasing to around 60% in the seventh and eighth decile groups, 46% in the ninth and 28% in the last decile.

The results according to scenario 2 show that with the exception of the last decile there is also a reduction in the average amount of tax obligation for the other decile groups. As an absolute amount, the most significant reduction is in the eighth decile (46.1 BGN), and the lowest is in the first and second decile (about 10 BGN). As a relative amount the reduction is 86% in the first decile, about 74% in the second and third, decreasing to 40% in the seventh and eighth decile and 16% in the ninth decile. In comparison to the base scenario, here the households from the tenth decile pay an average of 181 BGN more taxes, which in relative terms is 66%.

Table 3. Income Distribution by Decile Groups

Decile Groups	Baseline Scenario		Scenario 1		Scenario 2		Scenario 3	
	Disposable Income (BGN per month)	Market Income (BGN per month)	Disposable Income (BGN per month)	Market Income (BGN per month)	Disposable Income (BGN per month)	Market Income (BGN per month)	Disposable Income (BGN per month)	Market Income (BGN per month)
1	353.87	172.89	352.97	148.48	353.33	151.82	353.08	153.85
2	462.30	184.14	471.77	172.87	471.13	171.44	472.74	183.54
3	636.59	343.52	673.24	333.49	672.23	341.16	663.76	355.24
4	816.24	563.37	847.31	556.63	845.91	557.82	828.91	565.01
5	1,001.04	771.58	1,048.95	772.43	1,044.24	782.60	992.93	811.77
6	1,151.41	940.46	1,211.60	950.28	1,199.39	945.52	1,175.19	981.20
7	1,363.86	1,224.13	1,432.62	1,262.06	1,415.52	1,262.60	1,333.80	1,219.63
8	1,568.27	1,392.81	1,629.98	1,382.39	1,596.55	1,384.73	1,504.66	1,421.35
9	1,961.86	1,884.36	2,049.19	1,938.92	2,002.79	1,929.12	1,855.95	1,906.18
10	3,247.03	3,320.36	3,330.99	3,321.09	3,065.98	3,300.45	2,889.26	3,202.38

The results of the simulations under scenario 3 show a different impact in the low-income and high-income groups compared to the baseline scenario. In the first four decile groups is observed a reduction in the amount of due taxes of about 9 lv on average. In relative terms the reduction is 77% in the first decile, 49% in the second, 38% in the third and 20% in the fourth. For all households from the fifth to the tenth decile the average amount of taxes is higher. For the fifth decile the differences are immaterial and show that the increase is around 3 BGN or 5%. For the sixth and seventh decile the increase is 15 and 13 BGN respectively. As expected, both as absolute and relative amount, the differences in the tax model result in a substantial increase in taxes in the eighth, ninth and tenth decile, from 58 BGN in the eighth to 329 BGN in the tenth decile. In relative terms the simulated increase is from 50% in the eighth decile to 119% in the last decile. These results show that the households in the high income groups will be affected more than even under scenario 2, where the tax rate for the highest income is higher. The reasons for this result are largely due to the household income distribution in Bulgaria. There is probably a reflection of the EU-SILC sample structure, in which the highest income households are presented to a lesser extent.

Table 4. Amount and Share of Income Tax Liability

Decile Groups	Baseline Scenario		Scenario 1		Scenario 2		Scenario 3	
	Income Tax Liability (BGN per month)	Share by Decile Groups %	Income Tax (BGN per month)	Share by Decile Groups %	Income Tax Liability (BGN per month)	Share by Decile Groups %	Income Tax Liability (BGN per month)	Share by Decile Groups %
1	12.29	1.22%	1.37	0.29%	1.68	0.19%	2.77	0.19%
2	13.84	1.94%	2.81	0.81%	3.59	0.56%	7.09	0.64%
3	26.53	3.46%	5.15	1.32%	7.17	0.99%	16.51	1.33%
4	44.53	5.32%	11.41	2.79%	15.62	2.05%	35.51	2.73%
5	62.08	7.01%	18.26	4.18%	25.36	3.13%	65.31	4.85%
6	75.26	8.33%	25.68	5.71%	33.54	4.04%	90.08	6.15%
7	101.48	10.92%	40.63	8.83%	60.64	7.11%	114.62	7.93%
8	117.40	13.06%	50.19	11.42%	71.28	8.86%	175.55	12.79%
9	156.86	17.32%	84.28	18.65%	132.40	15.74%	271.33	18.91%
10	275.81	31.42%	198.01	45.99%	456.73	57.32%	604.97	44.49%

Interesting is also the comparative analysis of the relative shares of tax liability for each decile group in the total amount of tax obligation. The comparison of the results of the simulations in the baseline scenario and scenario 1 shows that in scenario 1 the sixth decile group including the relative size of the tax liability is lower. Under the baseline scenario 60% of the tax duty is distributed in the last three decile groups, in scenario 1 they pay 15 percentage points more or ¾ of the total tax. Similar results to those in scenario 1 are obtained in the simulations under scenario 3. Although the total tax distribution by decile groups is approximately the same, the results estimated in terms of absolute values of the average amount of tax liability, which in scenario 3 are more than three times higher, must also be taken into account (Figure 2). In scenario 2, nearly 60% of the obligation is distributed in households in the last decile, and ¾ - in those in the ninth and tenth decile. According to this scenario as relative weight in the total tax distribution the most favoured in comparison with the baseline scenario are households from the fifth to the eighth decile including. The relative share in the total tax for each group is about 4 percentage points lower than that in the baseline scenario.

5. Conclusion

As a result of the simulations of the three hypothetical scenarios with different taxation models and their comparison to the baseline scenario (current flat tax) the following major conclusions can be drawn:

1. The mixed results obtained under the different scenarios confirm the need for an in-depth analysis of the implications of various options of taxation models. The introduction of more progressive taxation models does not substantially affect the indicators of poverty and inequality compared to the baseline scenario. Thus, all political proposals for change in personal income taxation should be carefully considered in the light of the existing household and personal income distribution.

2. Overall, the most significant differences to the baseline scenario, which reflects the current "flat tax" model, are observed in the experimental model of scenario 3, in which the taxation model is a combination of a tax-fee minimum and relatively narrow income brackets with gradual increase in the tax rate. In this scenario, the estimated results indicate the most significant reduction of inequality.

3. It is necessary to further analyse how the changes in taxation models in various scenarios would affect households not only total and by deciles groups, but also the different types of households, such as ages, households with economically active persons, households with children, elderly and others. This additional information is essential for substantiation of any specific changes in the taxation model.

4. In future research it is important to experiment the so-called "budget neutral" reforms under which are simulated various taxation models without changing the tax revenue. This will give an answer to the question whether it is possible to reduce poverty and inequality without fiscal consequences.

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One New Solution of a Problem from Vojtěch Jarník International Mathematical Competition

Diko Souroujon, Teodora Zapryanova

University of Economics - Varna, Varna, Bulgaria
diko_souroujon@ue-varna.bg , teodorazap@ue-varna.bg

Abstract. The paper is dedicated to the Vojtěch Jarník International Mathematical Competition, held in Ostrava, 8th April 2016. One generalization of a problem given in this competition is considered.

Keywords. Bounded variation, differentiable function, Vojtěch Jarník International Mathematical Competition.

1. Introduction

The Vojtěch Jarník International Mathematical Competition is held at the University of Ostrava, Czech Republic every year in March or April. The competition is intended for university students who are interested in Mathematics.

It is the oldest mathematical competition for university students in the European Union.The competition was established in 1991 by a student of a student of Vojtěch Jarník and nowadays it is organized by students of a student of a student of Vojtěch Jarník.

There are two categories of competitors:

Category I is intended for a university student who does not attend and has not completed the 3rd year of the university studies of Mathematics (or similar branch) and who is less than 22 years old on the day of the Competition.

Category II is intended for a university student who has not completed university studies of Mathematics (or similar branch) and is less than 25 years old on the day of the Competition.

Competitors solve usually four problems in four hours. Problems are chosen by the jury which consists of university delegates.

Detailed information about the regulation of the competition is published at http://vjimc.osu.cz/, where one can find author's solutions of the problem.

Here we present second solution, different from author's of the following

Problem. (The 26th Annual Vojtěc Jarnik International Mathematical Competition Ostrava, 8th April 2016, Category II)

Let $f: [0, \infty) \to \mathbb{R}$ be a continuously differentiable function, satisfying

$$f(x) = \int_{x-1}^{x} f(t)dt$$

for all $x \geq 1$. Show that f' has bounded variation, i.e.

$$\int_{1}^{\infty} |f'(x)|dx < \infty .$$

Generalization. Let $f\colon [0,\infty) \to \mathbb{R}$ be a continuously differentiable function, satisfying

$$f(x) = \frac{1}{\alpha} \int_{x-\alpha}^{x} f(t)dt$$

for all $x \geq \alpha$, where α>0 is a fixed positive number. Show that f' has bounded variation, i.e.

$$\int_{\alpha}^{\infty} |f'(x)|dx < \infty .$$

The solution is given in section 2.

2. Solution of the Problem

If $f \equiv const.$, then the assertion is trivial and thus we suppose that $f \neq const.$ From

$$f(x) = \frac{1}{\alpha}\int_{x-\alpha}^{x} f(t)dt \tag{1}$$

it follows that

$$f'(x) = \frac{1}{\alpha}\big(f(x) - f(x-\alpha)\big). \tag{2}$$

From (1)

$$f(x-\alpha) = \frac{1}{\alpha}\int_{x-2\alpha}^{x-\alpha} f(t)dt = \frac{1}{\alpha}\int_{x-\alpha}^{x} f(t-\alpha)dt.$$

Subtracting the last expression from (1) and taking into account (2) we get

$$f(x) - f(x-\alpha) = \frac{1}{\alpha}\int_{x-\alpha}^{x}\big(f(t) - f(t-\alpha)\big)dt = \frac{1}{\alpha}\int_{x-\alpha}^{x} \alpha f'(t)dt = \int_{x-\alpha}^{x} f'(t)dt. \tag{3}$$

Thus, from (2) and (3) we obtain

$$f'(x) = \frac{1}{\alpha}\big(f(x) - f(x-\alpha)\big) = \frac{1}{\alpha}\int_{x-\alpha}^{x} f'(t)dt. \tag{4}$$

Let $f'(x) = 0$ for $x \in [x_0, x_0+\alpha]$ for some real number $x_0 \geq 0$, i.e. $f(x) = c = const.$ for $x \in [x_0, x_0+\alpha]$, $x_0 \geq 0$ is a real number. We will prove that $f(x) = c$, $\forall x \geq 0$. Indeed, from (2), $f(x-\alpha) = f(x) - \alpha f'(x)$ and then $f(x) = c$, $\forall x \in [0, x_0]$.

Let $x_1 = \max\{x: x \in [0,\infty): f(t) = c, \forall t \in [0,x]\}$, obviously $x_1 \geq x_0 + \alpha \geq \alpha$. From (2), we get

$$f'(x) = \frac{1}{\alpha}(f(x) - c) \text{ for } x \in [x_1, x_1+\alpha] \text{ and } f(x_1) = c.$$

Then for $x \in [x_1, x_1+\alpha]$, $\left(e^{-\frac{x}{\alpha}} f(x)\right)' = -\frac{c}{\alpha} e^{-\frac{x}{\alpha}}$ and by integration we get

$$e^{-\frac{x}{\alpha}} f(x) = ce^{-\frac{x_1}{\alpha}} - \frac{c}{\alpha}\int_{x_1}^{x} e^{-\frac{t}{\alpha}}dt = ce^{-\frac{x_1}{\alpha}} + c\left(e^{-\frac{x}{\alpha}} - e^{-\frac{x_1}{\alpha}}\right) = ce^{-\frac{x}{\alpha}} \text{ for } x \in [x_1, x_1+\alpha].$$

Hence $f(x) = c \quad \forall x \in [x_1, x_1 + \alpha]$. But this contradicts to the definition of x_1 and shows that $f(x) = c \quad \forall x \in [0, \infty)$.

Now our assumption is that $f \neq const$. Now let us define the function

$$q_0(x) := \frac{\left|\int_{x-\alpha}^{x} f'(t)dt\right|}{\int_{x-\alpha}^{x} |f'(t)|dt}. \tag{5}$$

This function is well defined, because $f \neq const.$ and $\int_{x-\alpha}^{x} |f'(t)|dt > 0$. Obviously $q_0 : [\alpha, \infty) \to [0, 1]$ is a continuous function.

Taking into account (4) and (2) we have

$$q_0(x) = \frac{|f(x)-f(x-\alpha)|}{\int_{x-\alpha}^{x} |f'(t)|dt} = \frac{|f'(x)|}{\frac{1}{\alpha}\int_{x-\alpha}^{x} |f'(t)|dt}.$$

Let us suppose that

$$\int_{x-\alpha}^{x-\frac{2}{3}\alpha} |f'(t)|dt \geq \frac{9}{20}\int_{x-\alpha}^{x} |f'(t)|dt \ . \tag{6}$$

Using (4), (5) and (6) one has

$$|f'(x)| = \left|\frac{1}{\alpha}\int_{x-\alpha}^{x} f'(t)dt\right| = \frac{1}{\alpha} q_0(x) \int_{x-\alpha}^{x} |f'(t)|\, dt \leq \frac{1}{\alpha} q_0(x).\frac{20}{9}\int_{x-\alpha}^{x-\frac{2}{3}\alpha} |f'(t)|\, dt$$

$$\leq \frac{20}{9\alpha} q_0(x).\frac{\alpha}{3} \max_{\left[x-\alpha, x-\frac{2}{3}\alpha\right]} |f'(.)|\,.$$

Since $q_0(x) \in [0,1]$, we estimate

$$|f'(x)| \leq \frac{20}{27} \max_{\left[x-\alpha, x-\frac{2}{3}\alpha\right]} |f'(.)|. \tag{7}$$

Thus (6) yields (7). Let now (6) be not true, i.e.

$$\int_{x-\alpha}^{x-\frac{2}{3}\alpha} |f'(t)|dt < \frac{9}{20}\int_{x-\alpha}^{x} |f'(t)|dt. \tag{8}$$

If $t \in \left[x-\alpha, x-\frac{2}{3}\alpha\right]$ is an arbitrary number, then by (8) we get

$$|f(t) - f(x-\alpha)| = \left|\int_{x-\alpha}^{t} f'(s)ds\right|$$

$$\leq \int_{x-\alpha}^{x-\frac{2}{3}\alpha} |f'(s)|ds < \frac{9}{20}\int_{x-\alpha}^{x} |f'(t)|dt = \frac{9}{20}\frac{\left|\int_{x-\alpha}^{x} f'(t)dt\right|}{q_0(x)}$$

$$= \frac{9|f(x) - f(x-\alpha)|}{20 q_0(x)}.$$

Hence $\forall t \in \left[x-\alpha, x-\frac{2}{3}\alpha\right]$ we have

$$f(t) = f(x-\alpha) + \big(f(t) - f(x-\alpha)\big) \le f(x-\alpha) + |f(t) - f(x-\alpha)|$$

$$< f(x-\alpha) + \frac{9|f(x) - f(x-\alpha)|}{20q_0(x)}. \quad (9)$$

By analogy $\forall t \in \left[x-\alpha, x-\frac{2}{3}\alpha\right]$ we have

$$f(t) = f(x-\alpha) + \big(f(t) - f(x-\alpha)\big) \ge f(x-\alpha) - |f(t) - f(x-\alpha)|$$

$$> f(x-\alpha) - \frac{9|f(x) - f(x-\alpha)|}{20q_0(x)}. \quad (10)$$

Thus

$$|f(t) - f(x-\alpha)| < \frac{9|f(x)-f(x-\alpha)|}{20q_0(x)}, \ \forall t \in \left[x-\alpha, x-\frac{2}{3}\alpha\right]. \quad (11)$$

Let now $\max\limits_{[x-\alpha,x]} f(.) = f(x_2)$ for some $x_2 \in [x-\alpha, x]$. Then by (5),

$$f(x_2) = f(x-\alpha) + \big(f(x_2) - f(x-\alpha)\big) = f(x-\alpha) + \int_{x-\alpha}^{x_2} f'(t)dt$$

$$\le f(x-\alpha) + \int_{x-\alpha}^{x} |f'(t)|dt = f(x-\alpha) + \frac{|f(x)-f(x-\alpha)|}{q_0(x)}. \quad (12)$$

By analogy, if $\min\limits_{[x-\alpha,x]} f(.) = f(x_3)$ for some $x_3 \in [x-\alpha, x]$, by (5),

$$f(x_3) = f(x-\alpha) + \big(f(x_3) - f(x-\alpha)\big) = f(x-\alpha) + \int_{x-\alpha}^{x_3} f'(t)dt$$

$$\ge f(x-\alpha) - \int_{x-\alpha}^{x} |f'(t)|dt = f(x-\alpha) - \frac{|f(x)-f(x-\alpha)|}{q_0(x)}. \quad (13)$$

Now using (1), (9) and (12), we obtain

$$f(x) = \frac{1}{\alpha}\int_{x-\alpha}^{x} f(t)dt = \frac{1}{\alpha}\int_{x-\alpha}^{x-\frac{2}{3}\alpha} f(t)dt + \frac{1}{\alpha}\int_{x-\frac{2}{3}\alpha}^{x} f(t)dt$$

$$< \frac{1}{\alpha}.\frac{\alpha}{3}\left(f(x-\alpha) + \frac{9|f(x) - f(x-\alpha)|}{20q_0(x)}\right) + \frac{1}{\alpha}.\frac{2\alpha}{3}\max_{[x-\alpha,x]} f(.)$$

$$\le \frac{1}{3}\left(f(x-\alpha) + \frac{9|f(x) - f(x-\alpha)|}{20q_0(x)}\right) + \frac{2}{3}\left(f(x-\alpha) + \frac{|f(x) - f(x-\alpha)|}{q_0(x)}\right)$$

$$= f(x-\alpha) + \left(\frac{1}{3}.\frac{9}{20} + \frac{2}{3}\right)\frac{|f(x) - f(x-\alpha)|}{q_0(x)} = f(x-\alpha) + \frac{49}{60}\frac{|f(x) - f(x-\alpha)|}{q_0(x)}. \quad (14)$$

By analogy, using (1), (10) and (13) we obtain

$$f(x) = \frac{1}{\alpha}\int_{x-\alpha}^{x} f(t)dt = \frac{1}{\alpha}\int_{x-\alpha}^{x-\frac{2}{3}\alpha} f(t)dt + \frac{1}{\alpha}\int_{x-\frac{2}{3}\alpha}^{x} f(t)dt$$

$$> \frac{1}{\alpha}.\frac{\alpha}{3}\left(f(x-\alpha) - \frac{9|f(x)-f(x-\alpha)|}{20q_0(x)}\right) + \frac{1}{\alpha}.\frac{2\alpha}{3}\min_{[x-\alpha,x]} f(.)$$

$$\geq \frac{1}{3}\left(f(x-\alpha) - \frac{9|f(x)-f(x-\alpha)|}{20q_0(x)}\right) + \frac{2}{3}\left(f(x-\alpha) - \frac{|f(x)-f(x-\alpha)|}{q_0(x)}\right)$$

$$= f(x-\alpha) - \left(\frac{1}{3}.\frac{9}{20} + \frac{2}{3}\right)\frac{|f(x)-f(x-\alpha)|}{q_0(x)}$$

$$= f(x-\alpha) - \frac{49}{60}\frac{|f(x)-f(x-\alpha)|}{q_0(x)}. \qquad (15)$$

Now by (14) and (15), we get

$$|f(x)-f(x-\alpha)| < \frac{49}{60}\frac{|f(x)-f(x-\alpha)|}{q_0(x)}. \qquad (16)$$

Hence in the case when $f(x) \neq f(x-\alpha)$ and (6) is not true, we obtain by (16), that $q_0(x) < \frac{49}{60}$, i.e.

$$q_0(x) = \frac{|f'(x)|}{\frac{1}{\alpha}\int_{x-\alpha}^{x}|f'(t)|dt} < \frac{49}{60}, \qquad \forall x \in [\alpha, \infty). \qquad (17)$$

But $\frac{1}{\alpha}\int_{x-\alpha}^{x}|f'(t)|dt \leq \max_{[x-\alpha,x]}|f'(.)|$ and from (17) we derive, that

$\frac{|f'(x)|}{\max_{[x-\alpha,x]}|f'(.)|} \leq \frac{|f'(x)|}{\frac{1}{\alpha}\int_{x-\alpha}^{x}|f'(t)|dt} < \frac{49}{60}$, i.e. in the case when $f(x) \neq f(x-\alpha)$

and (6) is not true, we have

$$|f'(x)| < \frac{49}{60}\max_{[x-\alpha,x]}|f'(.)|, \ \forall x \in [\alpha, \infty). \qquad (18)$$

If $f(x) = f(x-\alpha)$ and (6) is not true, from (2) $f'(x) = \frac{1}{\alpha}\big(f(x) - f(x-\alpha)\big) = 0$ and the inequality (18) also holds when $f \neq const.$ and (6) is not true.

In the general case, from (7) and the fact that $20/27 < 49/60$, we conclude, that

$$|f'(x)| < \frac{49}{60}\max_{[x-\alpha,x]}|f'(.)|, \quad \forall x \in [\alpha, \infty), \qquad (19)$$

when $f \neq const.$

Inequality (19) has basic role in the proof. We define $q_n := \max\limits_{[n\alpha,(n+1)\alpha]} |f'(.)|$, $n = 1,2, \ldots$ .The proof will be completed, if we show that $\sum_{k=1}^{\infty} q_k$ converges. But from (19),

$$q_{n+1} < \frac{49}{60} q_n, \quad n = 1,2, \ldots \ . \tag{20}$$

Indeed, let $q_{n+1} = \max\limits_{[(n+1)\alpha,(n+2)\alpha]} |f'(.)| = |f'(x_{n+1})|$.

From (19)

$|f'((n+2)\alpha)| < \frac{49}{60} \max\limits_{[(n+1)\alpha,(n+2)\alpha]} |f'(.)| = \frac{49}{60} q_{n+1}$, i.e.

$|f'((n+2)\alpha)| < q_{n+1}$, hence $(n+2)\alpha \neq x_{n+1}$, i.e.

$x_{n+1} \in [(n+1)\alpha, (n+2)\alpha)$.

Further from (19)

$$q_{n+1} = |f'(x_{n+1})| < \frac{49}{60} \max\limits_{[x_{n+1}-\alpha, x_{n+1}]} |f'(.)| = \frac{49}{60} |f'(x_{n+1,1})| \tag{21}$$

for some $x_{n+1,1} \in [x_{n+1} - \alpha, x_{n+1}]$.

If we suppose that $x_{n+1,1} \geq (n+1)\alpha$, then

$x_{n+1,1} \in [(n+1)\alpha, (n+2)\alpha)$ and from (21), $q_{n+1} < \frac{49}{60} |f'(x_{n+1,1})| \leq \frac{49}{60} q_{n+1}$, i.e. $q_{n+1} < \frac{49}{60} q_{n+1}$, which is a contradiction because $q_{n+1} > 0$.

Hence $x_{n+1,1} < (n+1)\alpha$, i.e. $x_{n+1,1} \in [n\alpha, (n+1)\alpha)$ and from (21) we get

$q_{n+1} < \frac{49}{60} |f'(x_{n+1,1})| \leq \frac{49}{60} \max\limits_{[n\alpha,(n+1)\alpha)} |f'(x)| \leq \frac{49}{60} q_n$, i.e. $q_{n+1} < \frac{49}{60} q_n$.

Thus (20) is proved. As a consequence of (20) one gets

$$\int_{\alpha}^{\infty} |f'(x)| dx = \sum_{k=1}^{\infty} \int_{k\alpha}^{(k+1)\alpha} |f'(x)| dx \leq \alpha \sum_{k=1}^{\infty} q_k$$

$$< \alpha q_1 \sum_{k=0}^{\infty} \left(\frac{49}{60}\right)^k = \frac{\alpha q_1}{1 - \frac{49}{60}} = \frac{60}{11} \alpha q_1.$$

Finally $\int_{\alpha}^{\infty} |f'(x)| dx < \frac{60}{11} \alpha \max\limits_{[\alpha,2\alpha]} |f'(.)|$. The proof is completed.

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Functional Model of a Data Intensive Real-time Web Application in the Live Betting Industry

Iliya Nedyalkov[1], Dimiter Velev[1], Ivo Damyanov[2]

[1] University of National and World Economy, Sofia, Bulgaria
Iliya.Nedyalkov@gmail.com, dgvelev@unwe.bg

[2] SWU, Blagoevgrad, Bulgaria
damianov@swu.bg

Abstract. The Online Gambling Market is one of the fastest growing markets in the world. Since 2009, the turnover has been doubled to up to 45.86 billion of dollars according to Statista.com. Live betting is the most preferable way to gamble online worldwide. The live betting sections of the gambling sites are very complicated web applications, which process real-time big data. Creating live betting platform is a very challenging and it is being improved on a daily basis - to be more sustainable, to process faster greater amounts of data and to send this data to increasing number of users. We will introduce a functional model, which can be used as a base for creating a successful live betting application, which interacts with Giga Bytes of data and spreads it, real-time to millions of users.

Keywords. Real-time web applications, NoSQL, live betting

1. Introduction

The Online Gambling Market is one of the fastest growing markets in the world. Since 2009 the turnover has been doubled to up to 45.86 billion of dollars according to Statista.com [1]. There are different types of games users can place bets on: sport events, casino games, lotto games, poker etc.

Sportsbook has the biggest share in the online betting - up to 47% [2] according to Paddy Power a leading British bookmaker, due to the fact that a lot of fans are appealed by global stars like Cristiano Ronaldo, Lionel Messi, LeBron James, Roger Federer and many others.

There are two types of sportsbook:

- Pre-match betting
- Live betting

SB Tech, one of the biggest worldwide sportsbook providers, announced that 60% [3] of the sportsbook turnover is generated through the live betting pages of its operators. SB Tech has more than 120 WHLs hence it is safe to assume that these statistics are applicable even towards operators, which do not use its sportsbook platform.

The utmost challenging to develop are the live betting pages in the online gaming sites. Live betting pages are facing several problems, which have to be solved in the development phase:

- The utmost challenging issue comes from the delay in delivering odds to the live betting page. Odds has to be delivered real-time otherwise, the users can take advantage of the delay and to bet before the change.

- The data which has to be processed and distributed in very brief time frames is pretty big. The database grows at extremely high pace, which affects the processing speed.
- The growing number of users causes leads to a huge amount of requests being sent to the server, which consecutively affects its performance.
- Live betting pages generates huge bandwidth, which is very expensive.

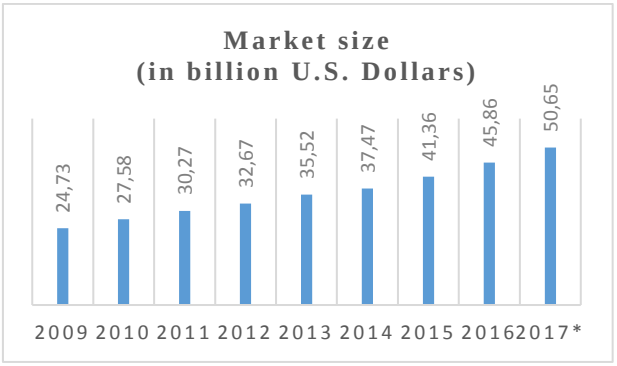

Fig. 1. Online Gambling Turnover since 2009

A successful functional model of a data intensive real-time web application would have an overwhelming and extremely high business impact over the entire live betting industry. We will discuss several different functional models and will focus on their pros and cons. Will try to propose a universal model which will cover all the needs of the live betting industry and resolve most of the problem its currently facing.

2. Functional models of data intensive real-time web applications

The functional models will be based on the different Internet communication technologies. There are two variations of communication based on:

- Pull technology
- Push technology [4]

Pull technology covers the standard way of request/response communication based on the HTTP protocol. The browser makes a request to the server and a communication channel is opened between the browser and the server. The server processes the request and returns a response to the browser using the same communication channel. Right after the communications channel is closed.

Functional model based on pull technology

Real-time web application based on the pull technology will need to make requests to the server to take the new odds frequently in short time frames. This will guarantee that the web page displays the latest odds to the users. The time frame between the requests varies from several hundreds of milliseconds to several seconds pending on how sensitive is the application to delays.

The different modules of live betting applications based on pull technology could be:

- Odds supplier
- Application which processes the odds and save them to a data store

- Web services which delivers the current odds on demand
- Applications which consumes data coming from web services

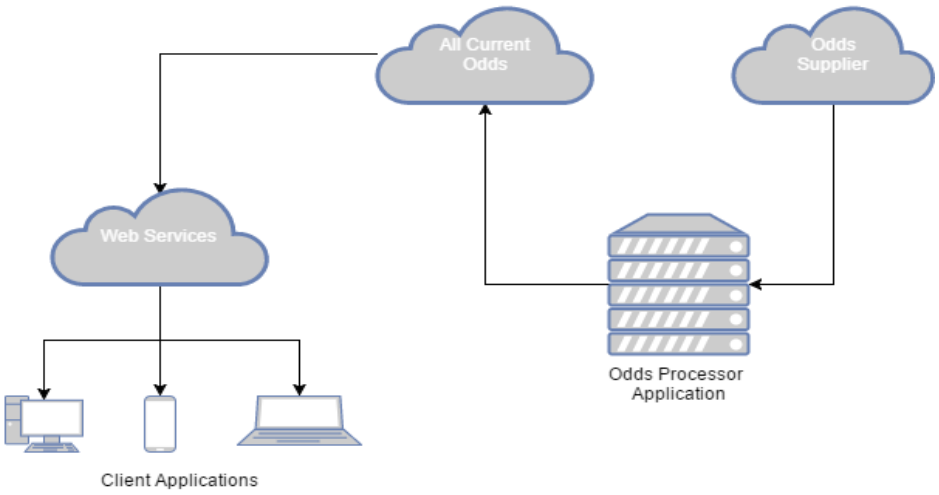

Fig. 2. Model of real-time web application based on pull technology in Live betting industry

Functional model based on pull technology is broadly used in live betting industry. It has number of advantages and disadvantages.

Advantages of the model based on pull technology:

- Easy to implement
- Easy to consume by the consumer applications
- Technology proven through the years

Disadvantages:

- Possible delays. Client application can make requests every second but the new data could come right after the response is sent to the server. This will cause a second of delay.
- Generating big amount of bandwidth

Functional model based on push technology

Web browser creates a handshake request to the server over HTTP. During the handshake if both parties support web sockets, the communication protocol is upgraded. The communication channel remains opened between the browser and the server for as long as it is needed. The communication between the browser and the server is full-duplex bi directional. The biggest difference between the request/response communication and the web socket one is that server could send info to the browser right after this data becomes available. The server does not need to await the client's application to make a request in order to send data.

The main module of the model is the push server. It receives odds from the odds supplier, process them, save them to the data store and sends them to its clients.

Advantages:

- Real-time data delivery in the moment data becomes available
- Minimum bandwidth

Disadvantages:

- More challenging and more time consuming to implement
- More challenging to integrate by clients' applications

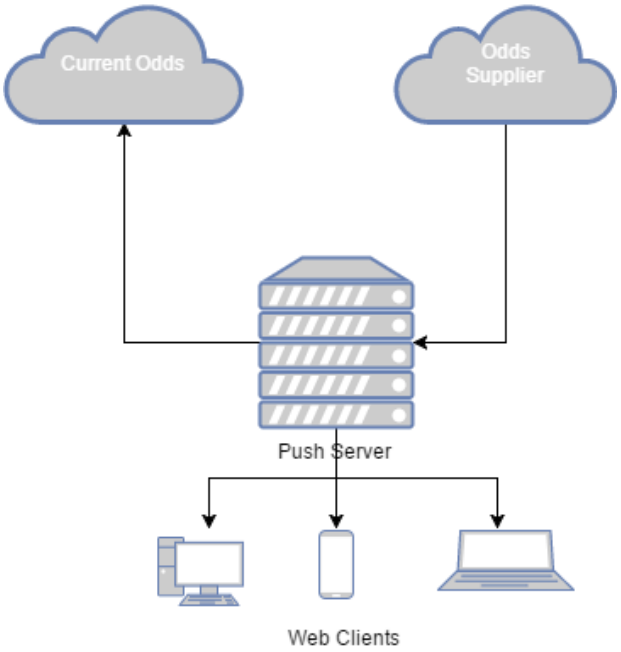

Fig. 3. Model of real-time web application based on push technology in Live betting industry

Hybrid model of data intensive real-time web application in live betting industry

As we see both models have its own pros and cons but a hybrid model based on both pull and push technologies will mostly contain the advantages and will minimize disadvantages.

In the hybrid model pull and push technologies are employed. This way the clients' applications, which prefer easy to integrate solution, will be able to consume web services on the other hand applications, which are very sensitive to delays, or to the network, traffic will be able to receive odds from a push server.

The aforementioned model is also interesting in that it use different types of data stores. We propose three types of data stores pending on the needs of the live betting applications:

- In memory data store to save all the current odds data. In memory data stores give very fast access to the data stored
- NoSQL database [5] could be used for storing historical odds changes. It will grow with terabytes every month

- Relational database could store the accounts data of the system.

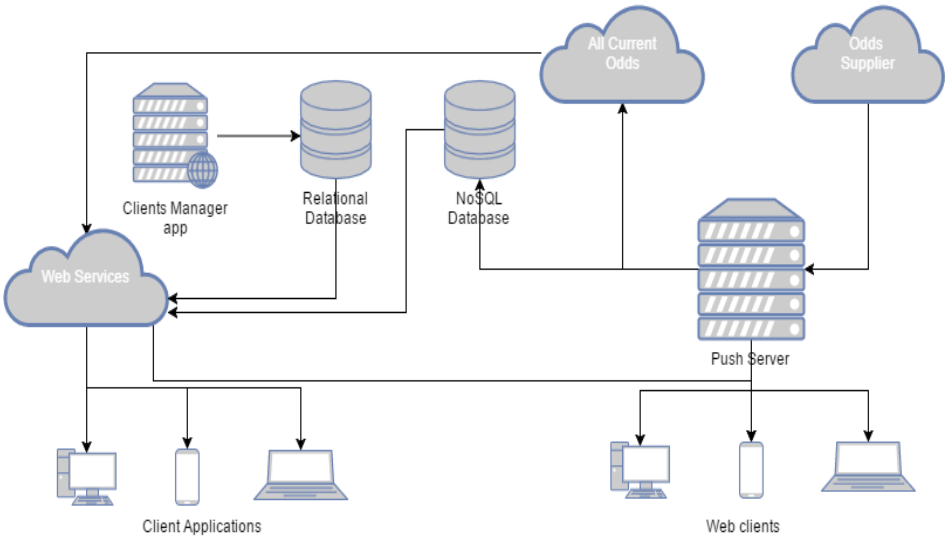

Fig. 4. Hybrid model of real-time web application based on push and pull technologies in Live betting industry

3. Conclusion

Live betting business is the hottest part of the whole online gambling industry. In order to facilitate it is growing the real-time web applications needs to resolve a lot of business problems.

The above mentioned hybrid functional model, would serve as a foundational for further prototype development which would cover the needs of live betting industry and resolve most of its problems. It combines advantages of the push and pull models by mitigating disadvantages. Yet another important advantage is the horizontal scalability and efficient migration for utilizing web sockets technology.

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Data Persistence Challenges in Microservice Applications

Ivan St. Ivanov

University of National and World Economy, Sofia, Bulgaria
ivan_st_ivanov@yahoo.com

Abstract. This paper looks into the data persistence consequences of breaking monolith applications into multiple microservices. The higher scalability and improved lifecycle of separate deployments come with a cost: if data is persisted in a single storage, separate microservices can't be delivered independently; otherwise transaction boundaries can't be used to ensure data consistency. The paper looks into the different aspects of the data persistence in a microservices application and proposes optimal solutions for specific microservices usecases beyond those mentioned in general distributed systems research.

Keywords. Microservices, Bounded contexts, Data persistence, Distributed systems,

1. Microservice architecture

Microservice architecture is architectural style that approaches developing a single application as a suite of small services, each running in its own process and communicating with lightweight mechanisms, often an HTTP resource API [1].

Microservices are small and autonomous abstractions that are handling particular business context of the big application. Each one of them can be implemented using different technology and framework. Separate microservices can be delivered and scaled independently of each other. [2]

It should be considered as the opposite to the monolith approach, where the application is developed, built and delivered as a single unit. The latter might consist internally of several components and submodules. But what is essential is that is deployed as a single archive.

We are going to use a sample moderately large web application to illustrate how a monolith is turned into microservices and what are the challenges that we face after that. It is a web store that sells goods. It was very well developed and its functionality was split into a few submodules. The diagram bellow presents the most important of them, Fig. 1.

The application consists of a Store submodule, which takes care of all the goods on sale, their current quantity and price. Then there is the User management submodule, which responsibility is logging in users, keeping track of their profile information and history. The Invoices submodule is responsible for getting right issuing invoices upon successful sale. Last but not least, the Forum submodule provides capabilities to e-store users to comment and rate the goods that are on sale.

The monolith model has its own benefits:

- Communication between submodules is straightforward and is based on API calls
- You deploy just a single artifact and let the target platform (i.e. the application server) take care of loading submodules and their dependencies in the proper order
- Monitoring one system is much easier than monitoring multiple ones. Same with debugging.

However, once the monolith application grows, its development and maintenance becomes more problematic compared to a fully modular solution. We will give three scenarios which prove that claim.

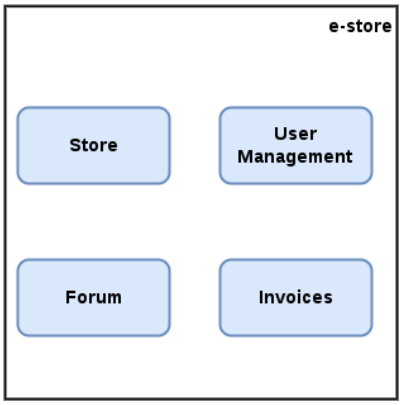

Fig. 1. Monolith application

Let's first come back to the delivery model of the e-store. It is deployed on a single server (real or virtual, doesn't really matter). This server needs to be running on powerful hardware to meet the application resource requirements. If in peak moments you decide to scale the application out by adding a new server, you have to purchase or borrow the same amount of hardware. Although the higher system requirements come just from the Store submodule, you must duplicate the whole server.

Another usecase is with updating the application. As its owner, you are delivering new features and bug fixes on a regular basis. As part of the monolith, you have to run significant set of tests across all the submodules in order to validate a small bug fix in the invoices generation for example. Or introduce unnecessary downtime in the Store for example, when you just want to deliver a small feature in the Forum. To avoid multiple downtimes, you might decide to deliver features and fixes of all modules together at a certain time interval (let's say once every two weeks). But in this way the teams that are working on each submodule would lose the autonomy to deliver capabilities at their own pace.

Developing a monolith application means sticking to one platform for all the submodules. This means that if the Store performs best if developed in Java backed by Relational Database, you have to use that for the whole e-store. No matter that another combination would be more appropriate for any of the other modules.

A microservice architecture can easily solve these problems. According to Dragoni et al [3]:

• Scaling a microservice architecture does not imply a duplication of all its components and developers can conveniently deploy/dispose instances of services with respect to their load

• Changing a module of a microservice architecture does not require a complete reboot of the whole system. The reboot regards only the microservices of that module.

• Microservices impose no additional lock-in and developers can freely choose the optimal resources (languages, frameworks, etc.) for the implementation of each microservice besides the communication protocol used for communication between them

So if we split our submodules into microservices, we can get an architecture that is more flexible to scale and easier to maintain:

Now each individual service can be scaled up and out independently from the others. The teams that develop each of them can now be responsible for the whole end-to-end delivery of new features as well as for picking the most suitable technology and framework to implement the respective microservice.

Of course, picking a microservice architectural approach does not come without

additional implications. One such implication is that the microservices are not completely isolated semantically. Which means that their share common concepts. For example the users defined in User Management service have their representations in all other modules.

The rest of this paper will explain this implication in depth and will describe and compare possible solutions.

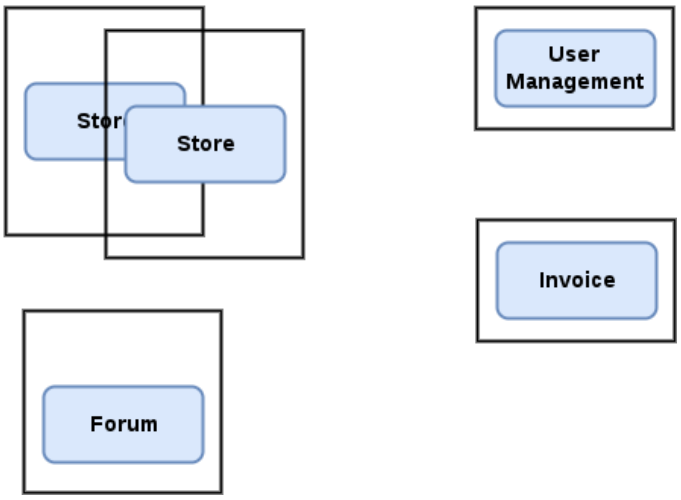

Fig. 2. Microservice architecture

2. Challenges with microservices data persistence

Modular or not, split to microservices or developed as a monolith, any reasonable application stores and manipulates data. In a classical three-tier application the single database is considered as a central source of truth. Even when the business layer is distributed across multiple server nodes, usually the database is shared.

Is this the right approach for microservice architecture too?

Let's start with a small example. Suppose that a microservice decides to update its database schema by for example modifying an existing table. This change has to be really carefully executed so that it doesn't break other services. In the best possible scenario it would include massive amount of regression testing. [4]

Another drawback of central database is that it is a one size fits all solution. Thus one of the most powerful features of the microservice architecture - independent technology decision of different services, is gone. On the other hand, if each service is allowed to pick and use its own data store, the services will determine the most effective way of storing their data [5].

Thus we come to the conclusion that that there are strong arguments for isolating each service's data in its own store. This is known as the Database per service pattern [6]. It mandates that the data should be kept private to the service and be accessible only via its public API. Thus it helps ensure that the services are loosely coupled: changes to one service context does not impact any other services.

Each service can use the type of database that is best suited to its needs. For example, if the Forum service does text searches, it could use ElasticSearch. If the User Management service also manipulates a social graph, it could use Neo4j.

It doesn't necessarily have to be a separate database per service. You can also have private tables per service or separate schema per service. [6] [7]

This approach however comes with a completely different class of challenges. Let's take the already mentioned microservices sharing common concepts (like Forum and User Management sharing the concept of a user). If we use a central storage, we would have a single table with information about the user and foreign key column(s) in the table(s) that refer to it. But in the separate database per service approach there are no shared tables. So there we need to have separate copy of the table in each store.

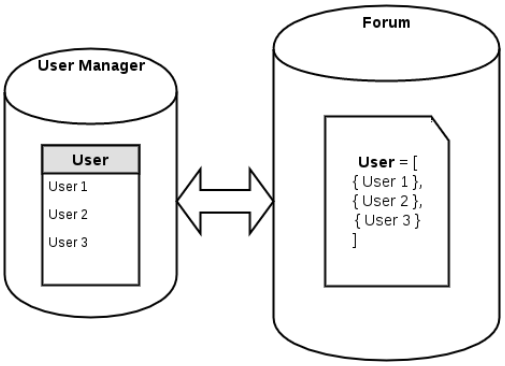

Fig. 3. Database per service pattern

Once we introduce that redundancy, we have to make sure that both tables are kept in sync. For example if a user changes their name, it will initially go to the User Manager's store. After that it has to be replicated to all other "copies" of that data, including the Forum.

Using distributed transactions that span multiple services does not help here. This type of transactions should be best avoided because of the CAP theorem. Moreover, many NoSQL databases (like the Forum in our above example) don't support them. [6]

The Database per service pattern has also other disadvantages like being harder to implement and more difficult to debug. In the next part we will focus, however, on solving the keeping data in sync challenge.

3. Solving the data in sync challenge

We have two microservices that have their own data storage. Each data storage may use different technology - relational database, document store or even filesystem. Two distinct services may need to store data about one and the same domain object. It is very important to note that the different microservices store their own view of the domain object. So even if they both use let's say relational database for that, the domain object may be stored in a table with completely different structure. If we go back to our user example - the User Manager stores things like user name, password and profile information. While the Forum is only interested in user's names and activity.

The problem that we want to solve is what if one of the microservices changes piece of data that is common with the other one. In our case, what if a user is registered in the User manager? Or if an existing user changes their profile picture. These events need to somehow get replicated to the Forum service as well.

One of the options is to make the User Manager call directly some kind of API of the Forum to announce the change. But this is not a good solution for two reasons:

- It introduces coupling between the two microservices. It is not necessary for the User Manager to know all the other services that deal with users
- User handling is not Forum's core business. That is why it should not be part of its public API

The best solution is to use event-driven architecture here. Services publish events when they update data. Other service subscribe to events and update their data in response. [6]

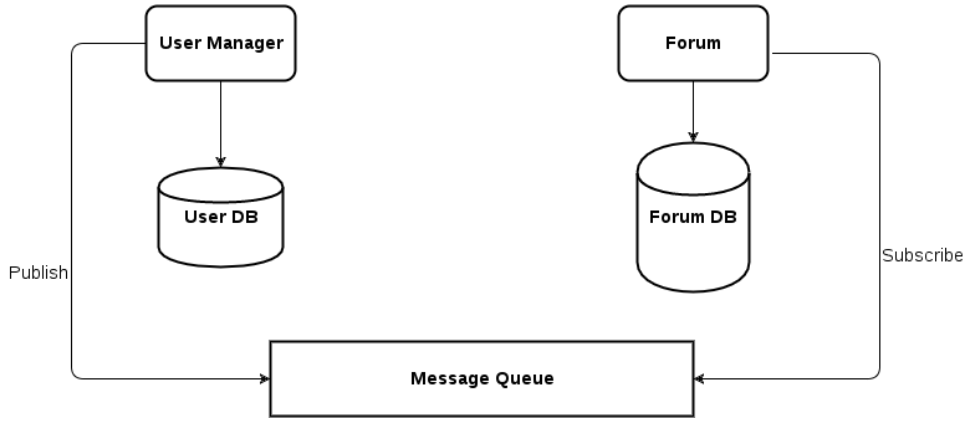

Fig. 4. Event driven architecture

Events are immutable structures that capture an interesting point in time that should be broadcast to peers. Peers will listen to the events in which they're interested and make decisions based on that data, store that data, store some derivative of that data, update their own data based on some decision made with that data, etc. [8]

The module responsible for handling those events is the Message Queue or Message Broker. There are a lot of message brokers on the market. Most of the traditional ones implement the AMQP standard: RabbitMQ and ActiveMQ to name a few. They all provide different styles of routing messages between producers and consumers, delivery guarantees, high availability, etc.

But most recently another solution gained popularity in this area. It is Apache Kafka and its capabilities go further beyond those of a message queue. According to its official website [9], it is a distributed streaming platform, where you can publish and subscribe for a stream of records. The streams are stored in a fault tolerant way and can be processed as they occur. According to a study [10], it is able to scale to up to 500,000 published and 22,000 consumed messages per second.

We've developed a small project [11] that showcases the usage of Apache Kafka in the context of a web store. It consists of two microservices - forum and user, which share the user domain object. In the first project the user representation includes its user name, display name and reputation points. In the second one the user attributes are user name, password, first and last name and email.

Users can be only added and modified in the user microservices. The forum microservice can just manipulate the reputation points. If a user is added or modified in the user service, the forum gets automatically notified and changes its representation accordingly.

Apache Kafka can be easily distributed to more than one node, so that it doesn't become a single point of failure in the microservice architecture. If any of the nodes stops functioning, the work will be performed by the others in a transparent to the other parties manner.

4. Conclusion

The microservice architecture allows teams to deliver software in much more flexible way than the traditional approaches. Not only it reduces coupling between separate application modules, but it enables autonomous release cycle and scaling. However, this comes with the cost of more complicated communication between different services. And this cost is mostly obvious when it comes to data persistence.

In this paper we showed how event driven architecture and publish subscribe mechanism can help in keeping different microservices data in sync. Finally, we showed how it can be implemented with one of the message processing systems on the market - Apache Kafka.

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Stochastic Evaluation of the Financial Ratios' Forecast Ability Using Principal Component Analysis

Ekaterina Tzvetanova

New Bulgarian University, Sofia, Bulgaria
e.tzvetanova@gmail.com

Abstract. Forecast ability of the financial ratios is risk sign of company insolvency. Its dynamic precede or follows an application for opening insolvency proceedings and therefore the evaluation is important for all financial statement users. In this study for the evaluation is used principal component analysis to remove the highly correlated ratios and to determine the most significant of them. The financial ratios are taken from financial statements of 49 insolvent and 49 solvent Bulgarian firms. The results will be used for adaptation to Bulgarian conditions of Altman's Z-score, which predicts the company insolvency.

Keywords. Insolvency, Forecast, Financial ratios

1. Introduction

Company's insolvency is a significant problem all around the world with high social costs which usually are undefined [1]. The prediction of corporate bankruptcy is critical for the financial statement's users, such as banks, lenders, investors, insurers, auditors and regulators and business consultants [2, 3]. Nowadays the importance of having a bankruptcy prediction tool is increasing because of both the boosting number of financial statements and the decreasing time for corporate analysis.

Predicting failure based on historical financial data is well documented topic. Since 1930 have been constructed more that 160 models [4]. However, there are no publications related to the construction of insolvency prediction models based on Bulgarian financial data. In this paper is made an attempt to identify an appropriate financial ratios, based on which to realize adaptation of Altman's Z-score model for identification of insolvency risk. In addition, it is made an attempt to construct variables based on several financial ratio. Those variables will be included in the analysis as a potential independent variables.

2. Methodology

In this paper the insolvency means that the company is applied for opening insolvency proceedings. It is used the financial data from the year preceding the application. The sample included 49 insolvent and 49 solvent Bulgarian companies. Insolvent companies were submitted an application for opening insolvency proceedings between 2010 and 2015 and had financial statements at least for four years. The solvent companies were extracted base on the matched pair sample meeting the following criteria: similar assets amount, same industry, available financial statement for the same period as the insolvent company.

This data will be used for adaptation of Altman's Z-score model using multivariate discriminant analysis. Using the latter technique requires meeting a number of assumptions, some of which will be investigated during the current analysis [5]:

- The data should be dichotomous - the groups should be discrete, recognizable and not

overlapped.

- The independent variables should be with multidimensional normal distribution.
- Lack of multicollinearity.

Laitinen & Suvas [6] have concluded that the most commonly used financial ratios do not reach the high enough accuracy with Bulgarian data. The latter is due to specific factors in the country which have a strong influence on forecast properties of the model. This requires an in-depth research of financial ratios to identify the appropriate one for the Bulgarian companies' data.

One financial ratio have to meet the following criteria:

- It has to ensure a clear difference between the two groups – solvent and insolvent companies.
- Its distribution have to be overlapped as less as possible between the solvent and insolvent companies which means that its discriminative power is strong.
- In general, the included financial ratios should have relatively low correlation between each other.

It is used the following analysis to find the appropriate financial ratios:

- Univariate analysis of the financial ratios including comparison of the means and variance as well as their distribution;
- Principal Component Analysis (PCA) based on which it will be removed the highly correlated financial ratios (above 0.9) as well as those with very low correlation. The remained variable will be included in a hybrid variables (variables based on several financial ratio).

PCA is factor analysis for data reduction which is used to determine the minimum variable which can explain a specific problem [7]. It is a linear transformation of data into a new coordinate system. The output is factor which is build up from several variables - in this case financial ratios. The factor denotes as ***F*** can be expressed as

$$F = Q * X \tag{1}$$

where vector ***Q*** gives the coefficients of the linear combinations used to compute the factors scores and matrix ***X*** which denote the included variables. The ***Q*** can also be interpreted as a projection vector because multiplying X by Q gives the values of the projections of the observations on the principal components.

In this study PCA is based on variables' correlation matrix. The applied method of rotation is Varimax because it is investigated for uncorrelated factors between each other. This technique maximize the sum of the variances of the squared loadings and investigate how groupings of variables measure the same concept [8].

3. Results

Univariate analysis. It was calculated 62 financial ratios separated in the following groups of indicators: cash-flow, profitability, efficiency, liquidity, indebtedness and other.

First, it was compared the means and variance between the insolvent and solvent companies for each financial ratio. Based on this it was rejected the hypothesis that there is no difference between the groups. In addition, it was highlighted the variables with high variance.

After that, it was made a distribution fitting between the insolvent and solvent companies for each financial ratio (Fig. 1). In most of cases the distribution was overlapped significantly between the groups especially when the ratio include net income or revenues. Moreover, the financial ratios has left or right skewed distribution. In cases when total assets are in numerator or denominator the financial ratio's distribution was tended to be normal.

Such analysis do not show how financial ratios interact each other and therefore the decision to remove some of them are not taken.

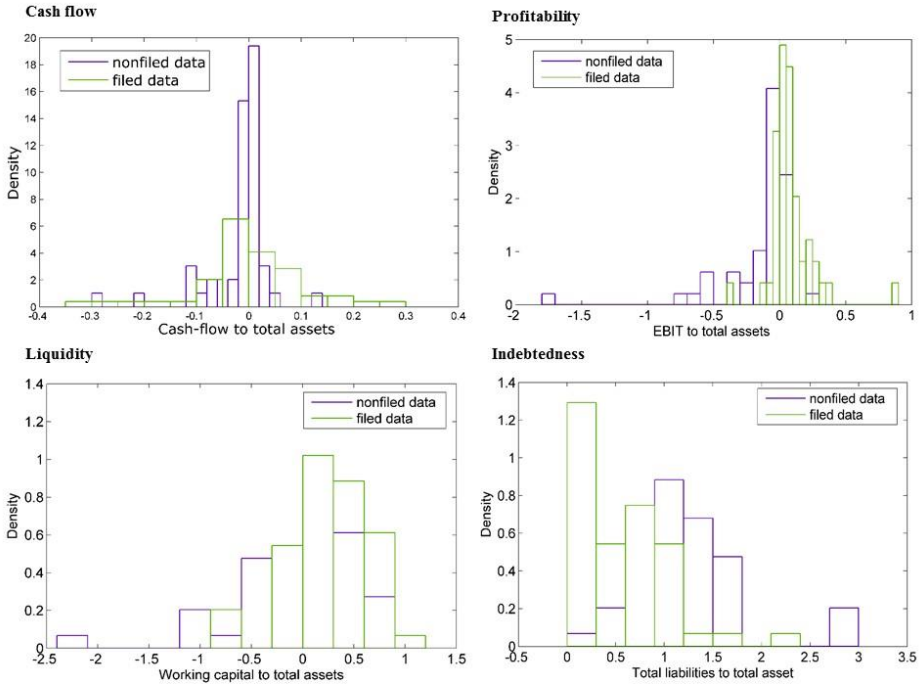

Fig. 1. The Distribution fitting of some financial ratios

Principal component analysis. The PCA was run on three stages - preliminary preparation, PCA application and validation. The used software was SPSS.

Preliminary preparation. It was included all 62 financial ratios calculated with data one year prior the insolvency. They were divided by groups and it was removed the significantly correlated data within the groups (above 0.9). The correlation coefficient are calculated using the Pearson *R*. Afterward, it was made a correlation analysis of all financial ratios together. It was remained 29 low correlated financial ratios (see Table 1).

In addition, it was removed the very low correlated data (below 0.3) because it is needed some correlation between the variables included in the factor. This financial ratios will remain for the model construction as well.

PCA application. It was made an attempt to construct a 4 factors based on the remained 13 ratios applying several iterations. The four factors represent the main group of the financial ratios - profitability, liquidity, efficiency, leverage (see Table 2). The four factors together were explained 75% of the cumulative variance which is enough high. The sampling adequacy of each factor wes on an acceptable level (see Table 2 - Kaiser-Meyer-Olkin measure of sampling adequacy). It was also rejected the null hypothesis that the correlation matrix is an identity matrix (see Table 2 - Bartlett's test of sphericity). However, the explained variance is not very high for the first three factors. Only the leverage factor has and acceptable level of explained variance.

Validation. The validation was made with data calculated two years prior the insolvency and with the average of the two investigated years. Analysis confirmed the results received from the firs years in term of correlation and significance of the financial ratios.

Table 1. Short list of financial ratios after removing of high correlated ratios

Profitability	Liquidity	Efficiency	Leverage	Other
EBIT to total liabilities	Current assets to total assets	Total income to equity	Long-term liabilities to equity	Retained earnings to total liabilities
EBIT to total assets	Quick assets to total assets	Total income to current assets	Long-term liabilities to total assets	Equity to total liabilities
Operating income to total liabilities	Cash and mark. sec. to total assets	Total income to working capital	Long-term liabilities to current assets	
Retained earnings to total assets	Cash to total assets	Total income to total assets	Long-term liabilities to total liabilities	
EBITDA to total assets	Cash to total liabilities	Total income to current assets minus inventories	Equity and long-term liabilities to total assets	
	Working capital to total assets	Cash to operating expendidures	Total liabilities to total asset	
	Fixed assets to total assets		Total liabilities to EBITDA	
			Financial debt to EBITDA	
			Financial Debt to EBIT	

Table 2. Statistics of the constructed factors

	The explained variance, %	Kaiser-Meyer-Olkin measure of sampling adequacy	Bartlett's test of sphericity	
			approx. Chi-Square	Significance
Profitability	67.12	0.62	84.37	0.00
Liquidity	60.20	0.66	152.78	0.00
Efficiency	61.41	0.64	49.02	0.00
Leverage	88.83	0.69	334.69	0.00

4. Conclusion

In this paper was analyzed a large group of financial ratios using univariate analysis and PCA.

Based on the univariate analysis it can be rejected the hypothesis that there is no difference between the group. In most of the case the financial ratios' distribution are left or right skewed, not normal. The financial ratios which include total assets as numerator or denominator may significantly meet the assumption for normal distribution.

Base on the PCA it was made a short list of appropriate financial ratios which are low correlated. In addition, was constructed four factors.

The following step will be to construct a model based on multivariate discriminant analysis using the short list of the financial ratios. Moreover, the constructed factors will be included in alternative model which to predict the insolvency risk.

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Design of Customer Perspective KPIs on the Basis of Purchase Funnel Approach

Snejina Lazarova

University of National and World Economy, Sofia, Bulgaria
snejinalazarova@gmail.com

Abstract. The paper presents an approach for defining customer perspective key performance indicators on the basis of the Purchase Funnel model. An organization's ability to manage its performance is of essential importance for its future development. Many organizations use the Balanced Scorecard (BSC) system to align business activities to vision and strategy. One of the most challenging perspectives of the Balanced Scorecard framework is the customer perspective. The Purchase funnel model provides a method of tracking the behavior a customer throughout the sales process and helps stakeholders to choose primary customer centric KPIs.

Keywords. Key performance indicator (KPI), Purchase funnel, Performance management.

1. Introduction

In order to successfully face progressive globalization and increased intense competitive rivalry, an organization's performance needs to be permanently monitored in all relevant areas. One of the key challenges with performance management is selecting what to measure. The priority here is to focus on quantifiable factors that are clearly linked to the drivers of business success. These are known as key performance indicators (KPIs). KPIs are a set of measures that a company uses to gauge its performance over time. KPIs vary between companies, industries and departments. Each department will use different key performance indicators to measure success based on specific business goals and targets. Different methodologies could be used for designing key performance indicators. This paper provides an approach for defining customer perspective KPIs which could be tracked back to the vision and the strategy of the organization.

2. The "Balanced Scorecard" Methodology

The Balanced Scorecard is developed by Robert Kaplan and David Norton in the early 1990s. The Balanced Scorecard is "a strategic planning and management system that is used extensively in business and industry, government, and nonprofit organizations worldwide to align business activities to the vision and strategy of the organization, improve internal and external communications, and monitor organization performance against strategic goals" [1]. It is perhaps the most used analysis framework. The Balanced Scorecard allows managers to look at the business from four important perspectives - financial perspective, customer perspective, internal perspective and learning perspective. The four perspectives in the original paper are shown below:

- Financial perspective – "To succeed financially, how should we appear to our shareholders?" [2]

- Customer perspective – "To achieve our vision, how should we appear to our customers?"[2]
- Internal business processes – "To satisfy our shareholders and customers, what business processes must we excel at?" [2]
- Learning and growth – "To achieve our vision, how will we sustain our ability to change and improve?" [2]

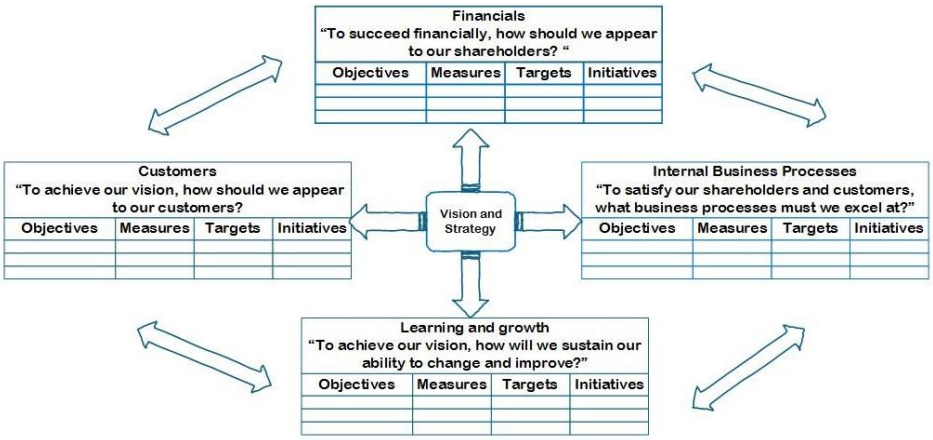

Fig. 1. The Balanced Scorecard provides a framework to translate the vision and the strategy of a company into operational initiatives

Each perspective consists of relevant strategic objectives, measures, targets and initiatives. "Key performance indicators represent a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization" [3]. KPIs reflects how well an organization is achieving its stated goals and objectives. For any of the KPIs, the actual value is measured and the evaluation of the current status is given (See Table1). Most often the evaluation of goal achievement is presented in qualitative categories – "good", "warning" and "bad".

Table1. A simple example of a strategic objective, measured by two KPIs. For any of the KPIs are given actual value, target value, status (evaluation of goal achievement) and planed initiatives.

Strategic objectives	KPI	Actual	Target	Status	Initiatives
Revenue growth	Revenue growth %	100%	120%	Warning	…
	Market share %	60%	61%	Good	…

The Balanced Scorecard is a general framework and does not specifically detail performance measures. The development of the measurement system is a task, which has to be solved according to the defined strategic objectives of the company. Selecting KPIs is one of the major challenges that companies have to face in developing a performance measurement system.

3. The customer perspective

The Balanced Scorecard highlights the importance of introducing performance measures which give a holistic overview of the company. In particular, KPIs has to embrace financial and non financial aspects. Non-financial information has drawn its importance these days due to rapidly increasing competition, dynamic market changes and changing customer needs and wants. Finding and retaining customers is a crucial task for every business. The company needs to know how many leads/sales they will need in order to see return of investment.

The customer perspective focuses on performance targets as they relate to customers and the market. These performance metrics are an absolute nesessity especially for complex Business to Business (B2B) sales. The company should have a metodical and well organized approach to building realtionships with customers, so that they can close more deals and meet their business goals.

4. The Purchase Funnel Approach

The purchase funnel, as defined by Gibson, is "a consumer focused model which illustrates the theoretical customer journey towards the purchase of a product or service" [4]. The Purchase Funnel model is ancestor of an early psychological model of customer behavior, which was first developed 100 years ago, named AIDA (acronym for Awareness, Interest, Desire, and Action). The term and approach are attributed to Elias St. Elmo Lewis [5]. According to AIDA, four stages could be differentiated in relationship of a customer to a product:

- Awareness – "the customer is aware of the existence of a product or service" [6]
- Interest – "actively expressing an interest in a product group" [6]
- Desire (or Decision) – "aspiring to a particular brand or product" [6]
- Action – "taking the next step towards purchasing the chosen product" [6]

During the 1960 the stages were often presented graphically as levels in a funnel. The important change in Purchase Funnel model, compared to the AIDA, is that the matter of modeling and measurement are not the psychological states of the customer (his subjective relationship to the product).

Customer's subjective perspective (AIDA):

Customer's activities:

The Purchase Funnel model presents a sequence of steps of the interaction between the customer and the company. AIDA and Purchase Funnel could be considered as two views of one and the same process. It is essential to develop the most suitable metrics for measuring each stage of the Purchase Funnel model. It is therefore the business objectives that should determine the choice of appropriate KPIs.

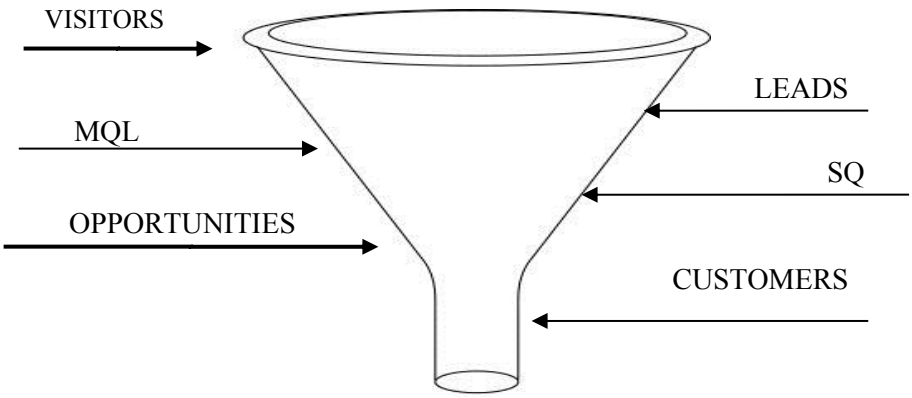

Fig. 2. Example of a Purchase Funnel

In the figure above are presented the following purchase funnel KPIs:

1. Visitors – Anonymous individuals viewing the website without much interest in pursuing
2. Leads – Visitors are converted to leads when they show interest in the product or service offered
3. Marketing qualified leads (MQL) – Prospects that have indicated a level of interest in the organization via a set of actions
4. Sales qualified leads (SQL) – These are prospects that are accepted form sales as worthy of a direct sales follow up
5. Opportunities – Opportunities are contacts who have become real sales opportunities
6. Customers – These are paying customers.

These KPIs can vary between different between companies and industries depending on the needs of the companies. Here is an example of the Purchase Funnel using the mentioned KPIs and sample values for each of the KPIs.

Fig. 2. Example of KPIs and sample values across the Purchase Funnel

The target for "Visitors" is defined as an absolute value, and for the rest of the levels, the KPIs are defined as conversion rates – the percentage of customers from the previous level, which come to the next level. The minimal set of KPIs, defined using the Purchase Funnel model could be presented in the Balanced Scorecard table format.

Table2. KPIs which are designed using the Purchase Funnel model and presented in the BSC table format

Strategic objectives	KPI	Actual	Target	Status	Initiatives
	Number of Visitors	200,000	300,000	Bad	…
	Visitors to Leads %	2.5%	2.5%	Good	…
	Leads to MQL %	6%	5%	Good	…
	MQL to SQL %	50%	45%	Good	…
	SQL to Opportunities %	40%	40%	Good	…
	Opportunities to Customers %	55%	60%	Warning	…

Using this approach the customer perspective KPIs which are designed using the Purchase Funnel model could be tracked back to the strategic objectives and the vision of the company.

5. Conclusion

The Balanced Scorecard allows managers to look at the business from four important perspectives - financial perspective, customer perspective, internal perspective and learning perspective. The Balanced Scorecard is perhaps the most used analysis framework. It is a general framework with four dimensions and does not specifically detail performance measures. Therefore complimentary models are needed for developing metrics, collecting data and analyzing it relative to each of these perspectives.

One of the most challenging perspectives of the Balanced Scorecard framework is the customer perspective. Many companies today realize the importance of customer focus and customer satisfaction and have a corporate mission that focuses on customers. Poor performance from this perspective is thus a leading indicator of future decline, even though the current financial results may look good. The Purchase Funnel model provides a method of tracking the behavior of a customer throughout the sales process and helps stakeholders to choose primary customer centric KPIs.

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Types of "Power" Users That Use Self-service BI Opportunities in Business Intelligence Systems

Violeta Ignatova, Alexandrina Murdjeva

University of National and World Economy, Sofia, Bulgaria
vilignatova@gmail.com, amurdjeva@unwe.bg

Abstract. Business intelligence systems are invariable part of a business daily routine for a big part of the organizations. With them there is a possibility to discover competitive advantage and possibilities for evolution in different spheres of activities. Except this, they are necessary skill for answering questions – big part from them needs fast reaction from the organizations. But business intelligence systems, applications, are achieving by specialists in IT department. The process for finding the needs and requirements from business users is complicated and slow that leads to the emergence of a new concept – self-service BI. To submit the right and effective possibilities for realizing the self-service BI is necessary to be analyze the end users that use these methods and skill. Generally, they can be categorized in two groups: "business" and "power" users. In turn, "power" users are called "users that have the power and possibility to manage the information that they have", can be categorize in the following groups – consumers, designers, analysts and statisticians. In practice, very often, they are not met in the clear way "power" users, but on the contrary – combination of the different skills that are specific for every type. The experience to classify the "power" users is necessary, as apart the information technologies, constantly changing the needs and the wishes of the business organizations.

Keywords. Business intelligence systems, self-service BI "power" users

1. Introduction

The information technologies are immutable part from daily processes of the business organizations. With them they generate, arrange and save the necessary economic information.

We are roundabout information and the striving for the right using increases more and more. The good analysis lead to find new opportunities and solve problem situations. To implement these processes are necessary the right tools – such as business intelligence systems.

The business intelligence systems are main component for managing the big economic organizations and not only. With them they have the opportunity to ensure the necessary quantity of data for preparing analysis – either for creating forecast or guiding the economic processes in the right direction. But whether the speed of the processes can be informationally guaranteed with this tool? Yes, definitely this is possible but in the context of the new concept – self-service business intelligence.

The self-service business intelligence is known as „giving power in the hands of the end user". The last creates alone the visualization for necessary data and generates knowledge that are helpful and right for the organization.

But whether every end user is able to master the specification of the considered concept and has the necessary knowledge to get the important aspects that is looking for? To answer of this question is necessary to show example of classification of end users and make try to summarize the necessary knowledge and skills.

2. Business users

There is not an accurate definition for "business users" but if we consider them in aspect of information technologies, and more concrete in business intelligence systems, we can say that they are the end users who use information. Yes, information that is created with the processes of generating, treatment, storage and afterwards – creating analysis.

Business users are all of the employers in the organization no matter where they are in managing layers – operative, tactical or strategic. But if we look at the business intelligence we can say that the business users are often managing authority in the mentioned managing levels. And here we can ask, why? It is the way because independently from a business process in the organization, the managing authority are the people who take managing decisions. They need from fast and good formed reports.

We can say that the business users are "consumers" of information that is used for creating analyses. This is necessitated by the fact that the reports are not created from these people who use them. In practice, the process of creating the necessary documents for analyze and support process for decision making is performed from IT department. This is reason for making errors that leads to different from planned results.

To reduce the percent of errors, to increase the process of obtaining the necessary information in the right time, to decrease the lack of coordination between managing authority and IT department and so on, the business users should be reviewed by a point of self-service business intelligence. Here they have the name "power users".

3. Power users

Power users are the people who are interested by information technologies sphere and make efforts to mix the daily work in the organization with information technologies. They divided by business users because access the data by using special way. The power users have research flair. They receive the necessary information by using powerful analytical self-service business intelligence tools.

The organizations rely on the power users. It is the way because they can be found in every department in the organization.

Big percent of power users are not "consumers", but "creators", of an information. But depending on what information must be extracted, they can be divided into the following groups:

Consumers

Except the business users, the power users also can be "consumers". The focus is placed no only into using generated information, but into using generated information from themselves. This kind of users create „ad-hoc"(improvised) reports where they use variables and interactive properties.

Most often, the power consumers use improvised forms that provide pre-selected sections of data. When changing the contents of warehouse / extract data and subsequent use of improvised forms, the data is automatically updated. Thus they limit the repeated recourse to the IT department, which is the main feature of self-service business intelligence.

Designers

Power designers are users who use self-service BI tools to create a better visualization of data. By "better" given more understandable.

The designers visualize data as build reports and dashboards that present the requested information graphically. For example: what is the proportion of goods sold from a product

range for the current month compared to past or projected. Furthermore, use different colors. This example can be given with the profit of an organization - to achieve projections for the current year. If achieved under estimated, it can be used red, which signals a lower profit. If realized more than planned, it can be used green, which signals a higher profit.

In organizations, however, not all employees perceive just graphics visualization. There are those who handle tabulation of data. This is the reason by which the designer of reports or dashboard must comply. Often found a combination of the two instruments. This integration allows a deeper insight into the information and better decision.

Analysts

The work of the power analysts is more complex than that of consumers and designers. Their actions are characterized by deeper insight into the processes of business intelligence. They are like that:

- creation of data models;
- integration of data from different sources;
- implementation of processes to extract, transform and load;
- analysis of geo-spatial data.

Presented by activities shows that analysts do not only produce data visualization, but also process the data.

Analysts create data models. Assess what quantitative and qualitative variables are necessary or would be needed. Thus providing an opportunity for making a variety of screens. Using the latest, allowing for a broader insight into business activity, which could lead, for example, to gain a competitive advantage over other organization in the field.

Processes for extracting, transforming and loading data and integration are closely linked. It could say that integration is part of the transformation of the data. Analysts, in this situation, precisely examine what sources work and pre-prepared plan to transfer the data warehouse / extract data.

Business intelligence in organizations is seen as a main activity of analysts. But they are specialized IT staff. In self-service BI concept aims to reduce IT intervention. This respectively means that few organizations in which the one who creates the visualization of data and processes managed by their processing and storage.

Statisticians

The latter type of power users of the classification are statisticians. Perhaps these are the smallest group of users. This is because required as business and IT knowledge and expertise in the field of statistics.

They are users who create forecasts; establish whether there are unseen relationships and dependencies between some of the business processes (data mining, for example - elasticity of the price of a product); using different statistical methods in the preparation of the tray, statistics and reports; They work with both structured data sources and unstructured; have the opportunity to prepare analyzes based on large volumes of data (big data), etc.

This group of users find their place in the respective classification of self-service BI users, because those processes performed using the tools of business intelligence. etc. Statisticians combine sophisticated mathematical and statistical principles with data preparation and visualization. Brose groups power users can be seen in the figure 1.

Power users do not always have just the characteristics of the species. In the majority of cases occur combinations. This is due to the fact that it calls for the combinations according to the needs of the business.

In practice, power user, but to a leading position may be interested in preparing the information base on which to make a decision. This process is accompanied by a combination

of knowledge of the analyst, designer and consumer. This means that prepares data displays them in an understandable way and eventually use them in order to present their vision or show why the decision was effective business organization.

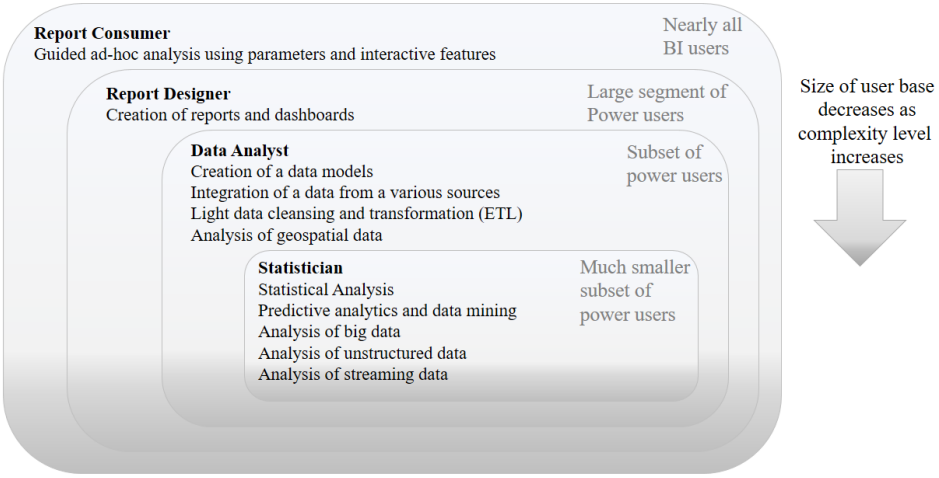

Fig.1. Types of "power users" use self-service BI opportunities

4. Conclusion

It is important to note that any consumer need or desire can not be covered if the power users perform only its typical traits. Moreover, we have seen that almost every endeavor to develop only in your comfort zone.

The key to self-service business intelligence applied by the types of users consists of three main steps: 1) must be available knowledge about the types of users and their BI comfort zones, 2) the establishment of specialized information of each user to be provided in an understandable for everyone in the organization manner and 3) use BI tools to offer this kind of functionality that can be accessed in demand.

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Frequently used self-service BI tools in business intelligence system

Violeta Ignatova, Alexandrina Murdjeva

University of National and World Economy, Sofia, Bulgaria
vilignatova@gmail.com, amurdjeva@unwe.bg

Abstract. The changing economic background is perquisite for changing the needs and requirements from a business side. Like an assistant, information technologies more often offer opportunities for guaranteeing the problem situations, finding new opportunities and offering the competitive advantage to the economic market. These processes are possible due to usage of business intelligence systems, in particular – self-service business intelligence. The end users that use self-service business intelligence systems are different, due to the different needs they have. This means that self-service BI tools that they use are different. The self-service BI tools can be categorized in some categories – for preparing reports (type user – consumer); for suitable graphical visualization (type user – designer); for complex analyses that allow deeper view of business process (type user – analysts); for preparing predictive reports, getting relations and dependencies known as "data mining", and such for tracing tendencies (type user – statisticians).

Key words. Business intelligence systems, self-service tools, type SSBI users

1. Introduction

The economic picture globally is changing along with changes in information technology. They are the main tool that enables organizations to monitor and manage their activities so that they are leading in the industry.

To gain competitive advantage, organizations require constant analysis of the processes carried out. This requires the help of intelligent business systems.

The business intelligent systems are not a new phenomenon, but enter the wider use in recent years. The executive authority of the organizations realize that no analysis of what is happening inside and outside, can not effectively manage their business and can not take adequate management decisions.

The business Intelligent systems are an ideal tool for ensuring the processes of resolving problem situations, identifying competitive advantages, creating forecasts and planning activities. But observe other phenomena that they can not ensure - the speed with which change needs and wishes of the governing bodies and the business as a whole. This is because the process of providing the necessary information in the form of reports, statements or panels supported by specialized IT staff. It needs time to change existing forms of information that slows the processes of decision making. This can sometimes result in an unacceptable result for the organization. That is why leading companies in the IT sector offering as a solution emerging concept - self-service business intelligence.

The self-service business intelligent systems offer tools to accelerate the processes of generating the information sought. The fact, however, is that it requires more specialized skills. To do this you first need to specify the range of end users who could use self-service business intelligent tools to determine what exactly needs can cover.

2. End users – business and power

The self-service business intelligence empowers end users to create their own reports without relying on IT department. By applying this business intelligent concept earn as consumers - receive the information they need, when they want, as they want, and IT departments - for them reduces the amount of work done on made them queries, allowing targeting of their strength on more worthy projects.

Before they purchase a self-service BI tools, companies must identify what users have, and if necessary to offer training courses.

End users can be business and power users. Business users are consumers of information generated. They are people who work in the organization. Most often, however, makes association with the governing authority as they mainly engage in the processes of decision making.

On the other hand, end users of self-service BI tools can be power users. It's staff in organizations with an interest in information technology and in particular to a self-service business intelligence. In contrast to business users, power users are divided into four main groups according to the type of activity which alone implement - consumers, designers, analysts and statisticians. Each of these types has those characteristics, but in its pure form do not occur. In reality, we are witnessing a combination of knowledge and skills relevant type of power user. This is because the needs of the organization are not always able to cover only the responsibility of the type of user.

Here is the moment to note that both business users are consumers, and in power users encounter this category. But there is a very distinctive band between the two types of users - while both only use generated by the IT department information, the other self-created information and then use it. Power consumers do not expect a response from the IT department and independent preparing what they need to prepare the necessary documents.

In practice, the power users group called creators. They have characteristics which can be represented according to the focus, which is arranged - 100% producers; access data - specialized; data sources - except warehouse and extract data to include them and external sources; and tools used - analytical or authoring tools.

3. Frequently used self-service BI tools

The current self-service BI tools are constantly changing depending on business consumers who use them. Compared to power consumers and other groups there are differences in functionality:

Consumers	Creators - designers, analysts, statisticians
Review	Customize
Navigation	Integration
Change	Creation
Research	Production
Modeling	Development

The governing authority of higher level, for example, require a review of static reports, statements and boards. Over time, however, may wish to replace static with dynamic. This means ask navigate dashboard, using breakdowns of predefined data or to set predefined filters.

On the other hand, the governing authority wish to move around data while changing them (add / delete columns, sort data, modify the appearance of diagrams, etc.). At some point,

however, the situation in which the governing bodies themselves were willing to create a visualization that they need. In some cases, this is related to providing access to data and respectively create data structures.

If you examine the levels of self-service business intelligent concept can be said that are three:

- creating documents for analysis - at this level includes pre-built dashboards that clearly direct users, regardless of the qualifications they possess. Thus leads to faster and better decision-making;
- Building a comprehensive visualization - it provides for the creation of new content - information which can be shared. The creation is based on data models already created;
- opening links and dependencies - integrate new data sources and combine with existing ones. The structures are subjected to processes by which seek undiscovered until now relationships and dependencies.

Overall self-service BI tools make intelligent business process easier for consumers, which allow the creation of greater analytical value.

Preparing reports

The creation of reports and statements is a process which is characterized by power consumers. The most commonly used self-service business intelligent tool is a table. In it they put differently shaped data passed through processing - mathematical, logical, etc. An example can be given with a total value of products sold in the current month.

If the content of the data is voluminous, place different filters on the basis of which to extract the requested content. For example, retrieving goods sold by a particular store (if you consider the retail chain) for the current month.

Tables can present grouped data. The most common of existing categories. This example can be given of how products such as unit sold and what is their value for a specific product range in the current month.

Not always, however tabulations is understandable to all employees. Therefore requires the use of other self-service business intelligent tools.

Suitable graphical visualization

The most commonly used self-service tools for making diagrams are graphical visualization. They provide a more understandable form. This is due to the fact that they allow the use of different colors. An example can be given if you compare daily sales figures of a shop with those planned. If the value is lower than the planned, the most commonly used red color. Opposite - if achieved higher results, it uses green color.

The charts have a different visualization - pie, histogram, bar, line, etc. Pie chart very well expressed as the proportion of total sales is due to the respective product range.

Another commonly used self-service business intelligent tool are the key performance indicators (KPI). Through this system creates evaluation, which helps the organization to determine the extent of reaching their goals. Furthermore possible to control the business activity of the company as a whole in real time. In practice key performance indicators are a tool for measuring targets.

Complex analyses for deeper view of business processes

In everyday life reports used as a synonym for analysis, but it did not. They differ in purpose to be placed, problems solved and the value they bring. Analyses are kind inquiries / reports and signs, which are derived meaningful ideas and are used to improve business

efficiency. The main objective is to answer any questions and problems.

The most commonly used self-service business intelligent tools here can be given combination thereof - tables, filters, charts, key performance indicators. The aim is to maximize the effective result.

Predictive reports, data mining and tracking tendencies

The most sophisticated creation are forecast data retrieval and tracking tendentious business processes.

Commonly used self-service business intelligent tools are "what-if" analyzes. These tools make it possible to evaluate the potential of certain changes in the business before they realized. Using historical data, it can see how different changes would affect some or other aspects of the business. For example, what would happen if you raise the price of goods by 10%? How this would affect the total sales? What would be the effect if you reduce the price and increase sales volumes? Analyzes of type "what-if ..." are a fundamental tool in business intelligent systems as provide an opportunity to assess the risks and benefits before deciding.

4. Conclusion

There is no recipe, which clarifies exactly which self-service BI tools to use in the analysis of data to extract maximum effect. This is due to the fact that different self-service BI tools offer different functionality. Resulting in the selection of instruments business needs; users who use the instruments or consumers who use the results obtained using instruments; price which can be acquired self-service BI tools onto, etc.

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Data Model for Near Real Time Analysis of Manufacturing Execution Systems (MES)

Anna Yordanova

University of National and World Economy, Sofia, Bulgaria
yordanovanna@yahoo.com

Abstract. There are many solutions, which follow the ISA 95 group of standards (Enterprise-Control System Integration). However, following the proposed functional hierarchy there is one limitation - the data is not available near real time due to the necessary transformation from one level to another. The accurate and on time data available for analysis is a competitive advantage. It is enabling on time reaction if a process is not running smoothly. The goal of this research is to propose a data model for near real time analysis of manufacturing execution systems (MES). MES (Manufacturing execution systems) track and document the transformation of raw materials through finished goods. This research will be a base for further development of Self-Service Manufacturing Intelligence Model.

Keywords. Manufacturing Data Model, Manufacturing intelligence, MES (Manufacturing execution systems), Plant Intelligence, Analysis of manufacturing systems data

1. Introduction

Operational performance management (OPM) is the alignment of all business units within an organization to ensure that they are working together to achieve core business goals. (TechTarget, 2017) Operational performance monitoring is necessary to enable managers and engineers to analyse the manufacturing systems data and find answers of many business questions, which will allow them to improve their processes and products quality. Therefore, there is a strong need in all plants to create or improve their business intelligence environment.

2. Manufacturing Standards and Literature Review

A manufacturer's sustainable competitiveness depends on its capabilities with respect to cost, delivery, flexibility, and quality (Forum, 2005)

ISA 95 standard describes the interface content between manufacturing operations and control functions and other enterprise functions. The interfaces considered are the interfaces between level 3 and 4 of the hierarchical model defined by the standard. The goals of the standard are to increase uniformity and consistency of interface terminology and reduce the risk, cost, and errors associated with implementing these interfaces. (ANSI/ISA-95.00.01, 2010)

Therefore, many manufacturing software vendors use the standard to enable the creation of a generic model by using common terminology shared across different systems in manufacturing.

ISA 95 group of standards consist of six documents described above:

- ANSI/ISA-95.00.01-2010 (IEC 62264-1 Mod) - Part 1: Models and Terminology

(ANSI/ISA-95.00.01, 2010)

- ANSI/ISA-95.00.02-2010 (IEC 62264-2 Mod) - Part 2: Object Model Attributes (ANSI/ISA-95.00.02, 2010)
- ANSI/ISA-95.00.03-2010 (IEC 62264-3 Mod) - Part 3: Activity Models of Manufacturing (ANSI/ISA-95.00.03, 2013)
- ANSI/ISA-95.00.04-2010 (IEC 62264-4 Mod) - Part 4: Objects and attributes for manufacturing (ANSI/ISA-95.00.04, 2012)
- ANSI/ISA-95.00.05-2010 (IEC 62264-5 Mod) - Part 5: Business-to-Manufacturing Transactions (ANSI/ISA-95.00.05, 2013)
- ANSI/ISA-95.00.06-2010 (IEC 62264-6 Mod) - Part 6: Messaging Service Model (ANSI/ISA–95.00.06, 2014)

B2MML or Business To Manufacturing Markup Language (B2MML, n.d.) is an XML implementation of the ANSI/ISA-95 family of standards (ISA-95), known internationally as IEC/ISO 62264. B2MML consists of a set of XML schemas written using the World Wide Web Consortium's XML Schema language (XSD) (XML , 2012) that implement the data models in the ISA-95 standard.

The Process Specification Language (PSL) defines a neutral representation for manufacturing processes that supports automated reasoning. Process data is used throughout the life cycle of a product, from early indications of manufacturing process flagged during design, through process planning, validation, production scheduling and control. In addition, the notion of process also underlies the entire manufacturing cycle, coordinating the workflow within engineering and shop floor manufacturing (NIST, http://www.mel.nist.gov/psl/, 2008).

The standard ISO 22400 focuses on key performance indicators (KPIs) for manufacturing operations management. KPIs are very important for understanding and improving manufacturing performance, both from lean manufacturing perspective of eliminating waste and from corporate perspective of achieving strategic goals(ISO 22400:2,)

The Current standards landscape for smart manufacturing systems report (Lu, Yan, K. C. Morris, and Simon Frechette., 2016) provides a review of the body of pertinent standards—a standards landscape—upon which future smart manufacturing systems will rely. This landscape comprises integration standards within and across three manufacturing lifecycle dimensions: product, production system, and business. In the report are discussed opportunities and challenges for new standards, and present emerging activities addressing these opportunities. This report will allow manufacturing practitioners to understand better those standards useful to integration of smart manufacturing technologies.

MESA has developed several models over the years. The current model, developed in 2008, spans from enterprise-level strategic initiatives to business operations to plant operations and actual production. It shows the interrelationships between strategies, enterprise-level operations, and plant operations. Objectives cascade down, and results are reported up against those objectives. It also provides a conceptual illustration of how events in the plant operation feed and inform all other events, and how aggregate views from the enterprise can drill down through operations to the real-time production views. (MESA, 2008).

Currently as part of the NIST project "Real-Time Data Analytics for Smart Manufacturing Systems Project" will be, develop standards, methods, and protocols for data analytics workflow to enable real-time diagnostics and prognostics that will significantly increase the efficiency of dynamic production system by FY18. The next generation of digital manufacturing requires the integration of complex physical machinery with networked sensors and with software for big data analytics across the product lifecycle. Implementing analytics across the product lifecycle functions offers new opportunities for process optimization. The focus is on big data analytics as one of the key multi-agency priorities. The application of big

data analytics is very important to manage complex manufacturing processes and supply chains. That report targeted industries such as aerospace where products are assembled with components from hundreds of suppliers around the world. (NIST, Real-Time Data Analytics for Smart Manufacturing Systems Project, 2017)

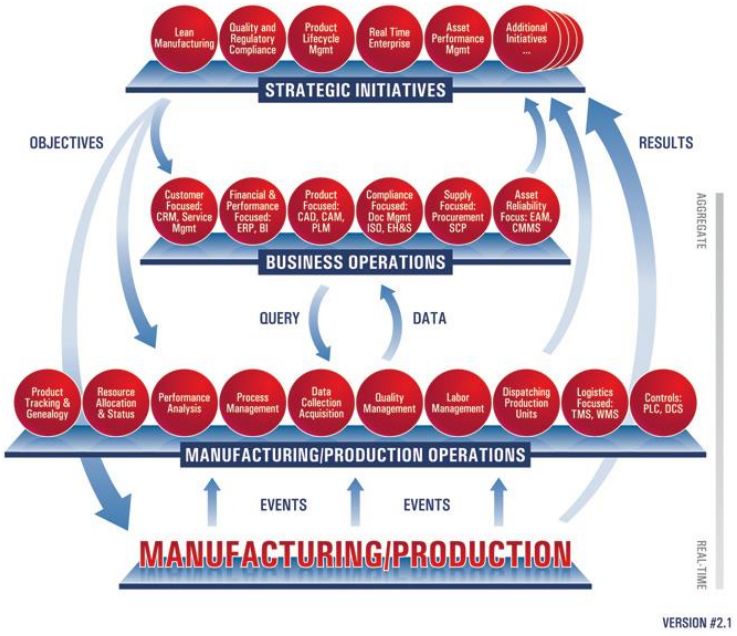

Fig. 1. MESA Model (MESA, 2008)

3. Methodology

There are many strategic initiatives, which can improve the manufacturing performance. The current research focus on Lean Manufacturing. The lean manufacturing key principals, Lean Six Sigma, DIMAC methodology (a data-driven quality strategy used to improve processes and tools enable the plants to improve dramatically their performance without affecting the quality). There are numerous key performance indicators, which can monitor to facilitate the continuous improvement process.

The first thing to start with is to identify the objectives, the corresponding critical success factors and the related metrics, which will enable continues monitoring and analysis.

There are many metrics described in the literature and used by the manufacturing plants. The current research identified 97 different metrics related to manufacturing operations management described in (ISO 22400:2,) and literature.

- Key result indicators (KRIs) tell you how you have done in a perspective
- Performance indicators (PIs) tell you what to do
- KPIs tell you what to do to increase performance dramatically

In addition to the performance measures, which are enabling monitoring of the critical success factors, are identified the different analytical areas which will be included in the model as well.

In each, analytical area has to be listed the attributes and measures necessary to be included in the model. Once the list is complete, make a mapping matrix to identify conformed

dimensions and report filters common for all analytical areas. During the analysis, design and development process, many questions find answers and the identified attributes find their best place in the model.

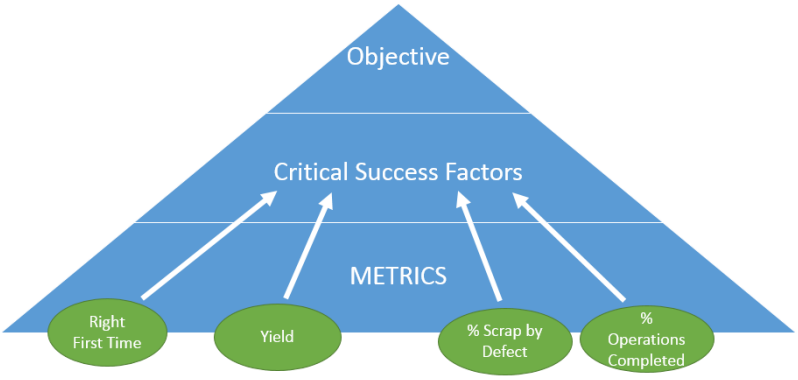

Fig. 2. Manufacturing Metrics, CSF, Objectives

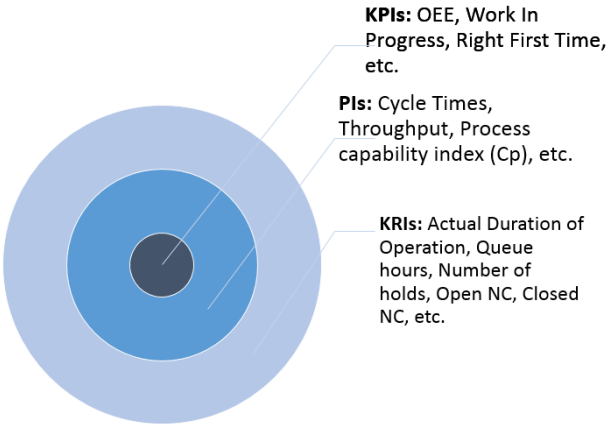

Fig. 3. Performance measures

4. Data model for near real time analysis of manufacturing execution systems (MES)

Below are listed some of the key design considerations for design of manufacturing intelligence data model (dimensions as central table, facts as peripheral tables) star schema model:

- Grouping facts. Analyze data granularity.
  - Any measure that aggregates along all the dimensions – additive
  - Any measure that aggregates along some of the dimensions – semi-additive
  - Any measure that has to be calculated along a dimension at each level – non – additive. Sample: Non-additive – typically calculated measure (% profit) we cannot sum the percent.

- Related facts to a particular subject area should be in the same fact table
- Facts with different granularity should be in different tables

(Analyze is it possible to put 2 facts with different granularity in the same table?)

- Denormalization of data
- Row-Level security of each analytical area
- Central table
  - Conformed dimensions – Shared by multiple fact tables and used when all business users have the same definition about the dimension. Sample: plant, cell
  - Additive facts – any measure that aggregate along all dimensions in the table.
- Peripheral tables – attributes and measures related to a particular analytical area.

(Yordanova, 2015)

5. Analytics Maturity model

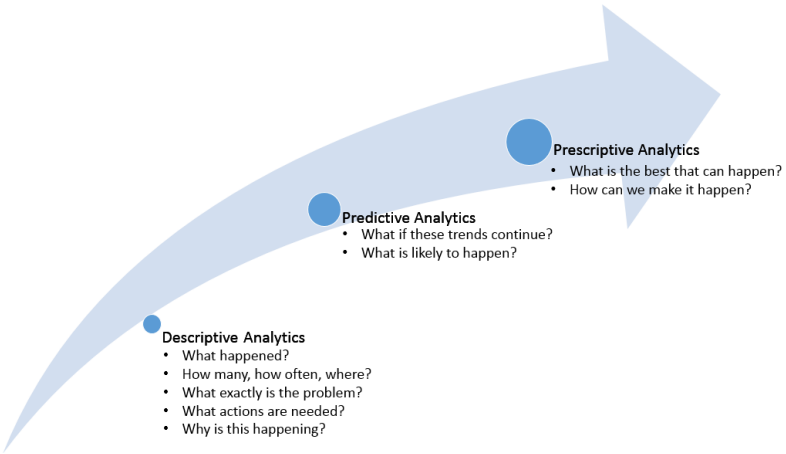

Fig. 4. Analytics Maturity Model

Analytical transformation is an ongoing process. According (Melnychuk, 2016) we will see more transformation in the future: system implementations, restructuring of processes, re-defining and simplifications of the models, automation of the routine tasks and applying proactive advanced analytics. (Melnychuk, 2016). When developing a data model for near real time analysis of manufacturing execution systems not all goals can be achieved as part of the first release. Therefore, one approach is first to focus on descriptive analytics, then as part of second project cycle to include predictive analytics and after that to add prescriptive analytics. This will enable the business community to provide feedback after each stage and improve the overall manufacturing intelligence environment and user experience.

6. Conclusion

"Unless we can keep our eyes on the ball we'll lose sight of what we are trying to achieve" (Friedrich Nietzsche, Philosopher) Therefore, to enable near real time monitoring of the manufacturing operations management is vital for the factories to achieve their strategic goals. The proposed model allows constant improvement and expansion, which will support continuous improvement initiatives, integration of new data sources, row level security.

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Self-Service Business Intelligence for Manufacturing Analysis

Anna Yordanova

University of National and World Economy, Sofia, Bulgaria
yordanovanna@yahoo.com

Abstract. Self-service business intelligence is allowing the end users to design and deploy their own reports and analyses within an approved and supported architecture and tools portfolio. This research aims to propose a conceptual and data model for near real time self-service business intelligence for manufacturing analysis.

Keywords. Manufacturing intelligence, MES (Manufacturing execution systems), Plant Intelligence, Manufacturing Systems Data, Self-Service Manufacturing Intelligence,

1. Introduction

The business case for Business Intelligence is well established. Access to Business Intelligence is what gives companies their competitive edge and allows them to discover new business opportunities. (Imhoff, Claudia; White, Colin, 2011) The self-service approach is well known and the people are using it already in many areas. There are many reasons like lower cost, independence, faster service, anytime can be accessed, in some cases anywhere (for example: online banking, web services, etc.)

However, at the same time self-service business intelligence is well-known topic and an area, which still needs improvement in order to allow easy adoption. Moreover, there are many business and technical challenges to satisfy business community expectations.

2. Definition of Self-Service Business Intelligence

According (Gartner, 2017) self-service business intelligence is defined here as end users designing and deploying their own reports and analyses within an approved and supported architecture and tools portfolio. (DIY BI: A guide to self-service business intelligence implementation, 2017) defines self-service business intelligence (SSBI) is an approach to data analytics that enables business users to access and work with corporate data even though they do not have a background in statistical analysis, business intelligence (BI) or data mining. According (Imhoff, Claudia; White, Colin, 2011) two themes — ease of use and information consumability — that play crucial roles in a fully functioning SS BI environment.

(Alpar & Schulz, 2016) self-service concept with respect to different tasks: access to prepared reports or data resources, direct access to data, access to functions, or creation of new resources. The system support necessary varies with these tasks. A corresponding classification in Fig. 1. Software applications or systems exist for each of the shown levels.

3. Current Self-service business intelligence Trends

The way BI is embedded into applications has changed immensely since the mid-1990s. (See Table 1.) (Eckerson, 2016)

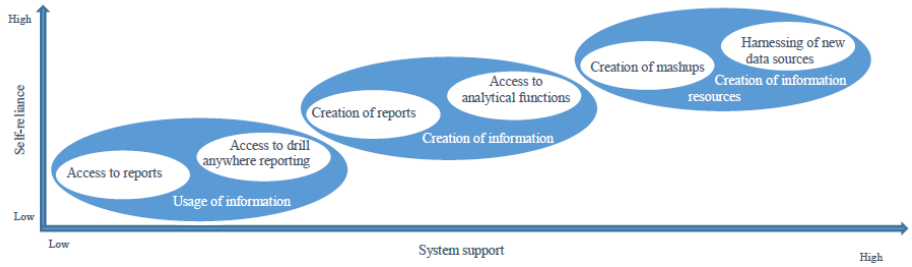

Fig. 1. Levels of self-service (Alpar & Schulz, 2016)

Table 1 Evolution of Embedded BI

Decade	BI User Features	Data Sources	Platform	BI Software	Client Code	APIs	Developers	Pricing
1990s	Static Reports	RDBMS, files	Desktop	Desktop BI tools	Windows, Unix	Code-specific libraries	Independent software vendors (ISVs)	User-based
2000s	Interactive reports, OLAP, dashboards	OLAP and XML	Web	Web BI tools	ActiveX, JVM, Flash, Silverlight	SOAP, iFrames	ISVs and internal developers	Server-based
2010s	Self-service, predictive, and blended analytics	Cloud apps, big data, NoSQL, streams, search	Cloud	BI platforms	AngularJS, Ember.js jQuery, AJAX, etc.	REST, JavaScript,	ISVs and internal developers	Value-based

For instance, the type of embedded analytics functionality has evolved from static reports in the 1990s to interactive reports and dashboards in the 2000s to self-service, predictive, and blended analytics today. In addition, embedded BI tools can now access a much broader range of data than relational databases, which were the predominant data source in the 1990s. In the 2000s, BI tools could routinely query OLAP and XML sources, and today, many support a bevy of cloud applications and big data sources. Moreover, embedded analytics software moved from the desktop to the Web 15 years ago and now runs in the cloud, where organizations can rent the software on a monthly (or sometimes hourly) basis. Web and cloud-enabled BI applications run on separate servers and thus share no code or libraries with host applications, making it easier to embed analytics. (Eckerson, 2016)

When evaluating BI tools' business user self-service capabilities, Forrester recommends considering features and capabilities including (Evelson, Boris; Powers, Stephen; Kisker, Holger, Ph.D.; Yuhanna, Noel; Coyne, Shannon;, 2011): Automodeling; calculated measures; collaboration; data virtualization and drill anywhere; prompt for columns; Search-like GUI; Write back; Exploration and discovery.

Forrester's 60-criteria evaluation of enterprise business intelligence (BI) platform vendors, identified 11 significant software providers — IBM, Information Builders, Microsoft, MicroStrategy, OpenText, Oracle, Qlik, SAP, SAS, Tableau Software, and TIBCO Software — and researched, analyzed, and scored their current market offerings. The report details how

well each vendor fulfills Forrester's evaluation criteria and where they stand in relation to each other to help application development and delivery (AD&D) professionals select the right vendor for their enterprise BI platform (Evelson, Boris; Kisker, Holger,Ph.D; Bennet, Martha; Christakis, Sophia, 2015)

4. A Conceptual Model of Self-Service Business Intelligence for Manufacturing Analysis

The self-service business intelligence conceptual model for manufacturing analysis considers data integration from many plants to allow analysis and comparison of plants operational performance. Consistency of data is important and require proper analysis to enable consolidation regardless the plant is manufacturing or assembly. The data model for manufacturing analysis must be capable of encompass data consolidated from many data sources like MES (Manufacturing Execution System), Visual Inspection Systems, etc.

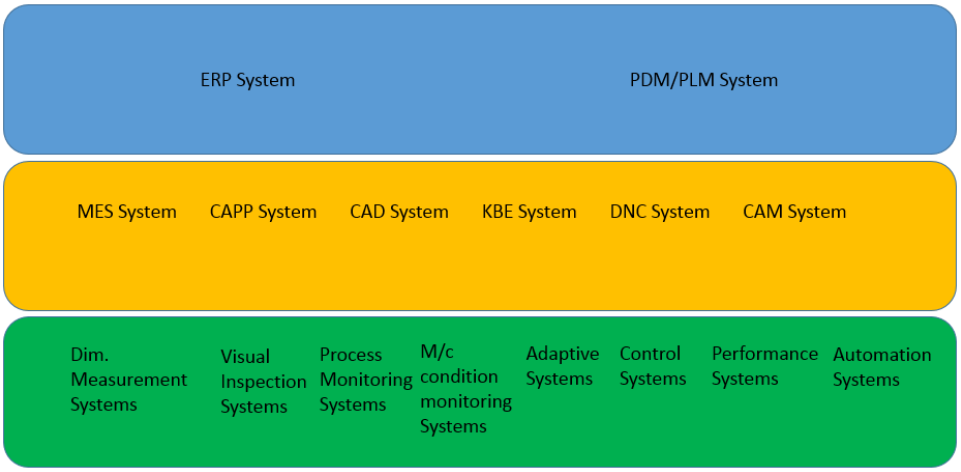

Fig. 5. Manufacturing systems at different organizational levels

The first step is to integrate the data from all plants, the corresponding data sources used in each plant to support plant operations and integrate the data into a single database. In the database, a star schema model enables the users to make their own queries. The central entity consist of conformed dimensions. They are bridge between the different analytical areas. The conformed dimension table items are used as common filters in the queries and reports.

The Prebuild Flexible Reports have obligatory or optional filters.

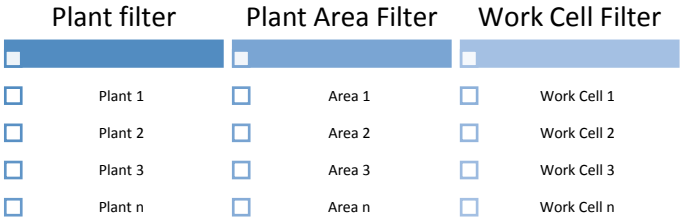

Fig. 6. Sample report filters

However, in addition the users can enable or disable all available items in the reports (charts, tables). This will allow them to create report versions and save these versions or bookmark the report view. The user may decide what data to summarise, what charts to display, what tables to display, what columns to display in each table and how to filter the data, from all the possibilities available in the reporting solution.

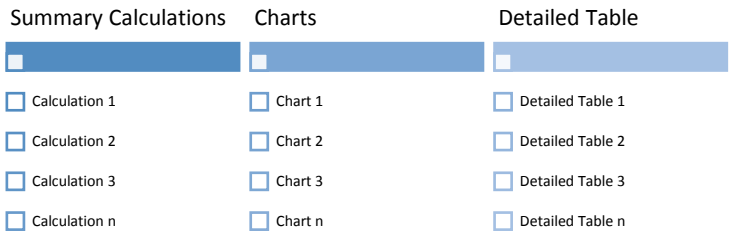

Fig. 7. Filters enable or disable all available items in the report

The reports can be very flexible. A report version will show on the screen only those elements chosen for display by the user. For example, the user can choose summary items, charts and tables displaying the charts data, enabling detailed table.

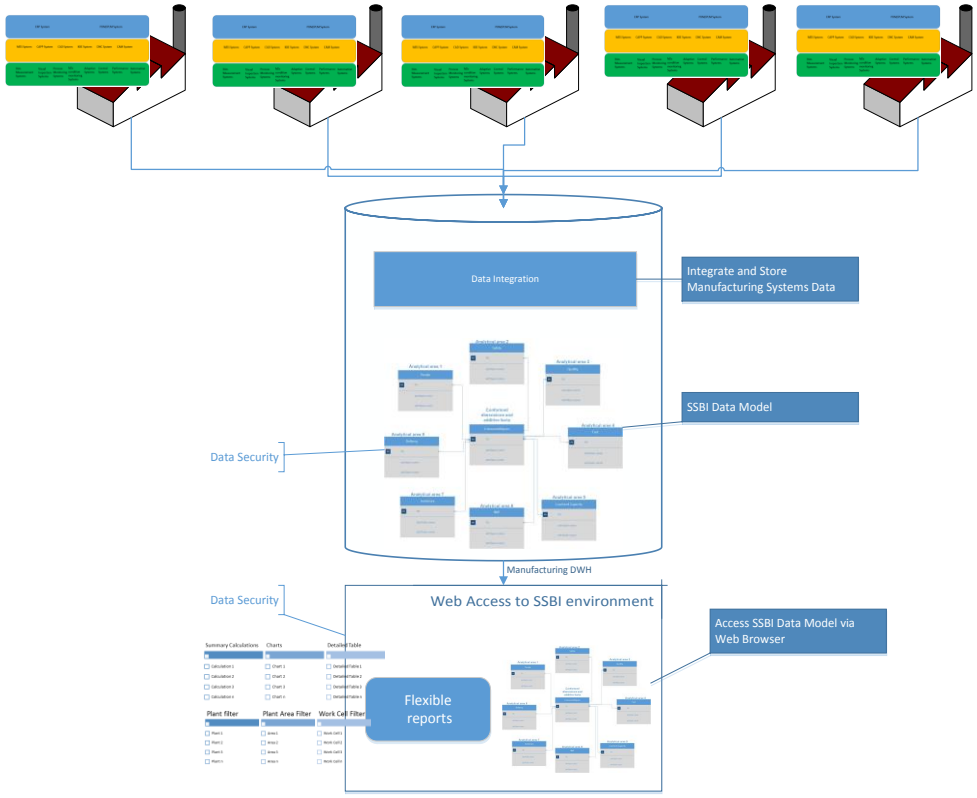

Fig. 8. A Conceptual Model of Self-service business intelligence for manufacturing analysis

5. Conclusion

The proposed conceptual self-service business intelligence model can be developed with different database and business intelligence applications. However, there are many business requirements, which can reduce the list of available software like row level security and reports security (Active Directory integration), near-real time analysis, etc. The data volumes generated by the different shop floor systems can vary depends on the plants type and products. This will influence the decision about business intelligence platform in addition. Nevertheless, the proposed data model and reports functionality can be a powerful enabler of self-service business intelligence regardless the BI software and hardware used.

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Analysis of Methods for Developing Key Performance Indicators in Information Security

Veliko Ivanov

University of National and World Economy, Sofia, Bulgaria
velikoivanov@unwe.bg

Abstract. The paper presents and classifies methods for developing key performance indicators (KPI). Different approaches are reviewed and analyzed. Marked are strengths and weaknesses of reviewed methods. There are given examples of KPI based of the presented methods. Possibility of universality of methods is discussed.

Keywords. Key performance indicators, Information security, University business processes.

1. Introduction

Every organization seeks to improve the security of its processes in order to reduce risk and maximize business results. In many cases, assessing the progress of the organization in this area is associated with the use of both conventional indicators and indicators based on an analysis of company's specifics. The term "key" brings together these two groups of indicators. Definition of key performance indicators (KPIs) used in this paper is: KPIs are qualitative and quantitative indexes used to measure the progress of the organization in achieving its goals [1].

There are many KPIs [2] created to take part in the evaluation of information security of an organization. KPI selection is a process that does not always end with satisfactory result. In depth analysis and design is needed to build KPIs which to present a complete picture about the state of the company. There are number of methods by which a developer can build appropriate KPIs.

2. "Top-down" method

The method [3] consists in selecting appropriate objectives at the highest level by the management. The key reason to success and starting point in this model is the commitment of management, followed by the preparation of policies and procedures. At the end result-oriented metrics analyses take place (Figure 1). This method, in nearly all cases, is based on checklists models like Cobit [4] in realization phase.

There are three disadvantages in this method that experience shows:

− Difficulties in defining information requirements for KPIs by the management;

− The process of defining KPI, in nearly all cases, becomes too complex because every organizational unit is involved;

− Inability to calculate firstly defined KPI due to insufficient information.

The "Top-down" method is based on the GQM (Goal – Question – Metric) process (figure 2). It is a simple, three-step process for developing security metrics [5]. The first step defines the goals that management hopes to achieve. Most of the time these are not measurement goals, but objectives. The second step is to divide the goals into specific

questions, which at last should be answered by measurement of properly defined metrics (variables).

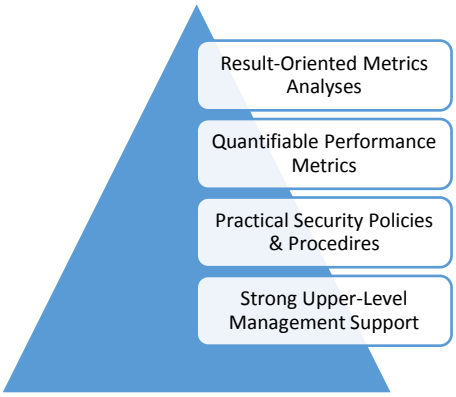

Fig. 1 "Top-down" method

GQM process as part of "Top-down" approach tries to align the low level data with the higher level goals and to minimize the third disadvantage of the method, discussed before.

The GQM process traces its roots back through software engineering practices into the 1970s, primarily through the academic and industry research conducted by Victor Basili of the University of Maryland [5].

Using GQM to build security metrics provides at least one important benefit - measurement activities are inherited and bounded by the goals, which increase the chances that the KPI design process won't lose focus.

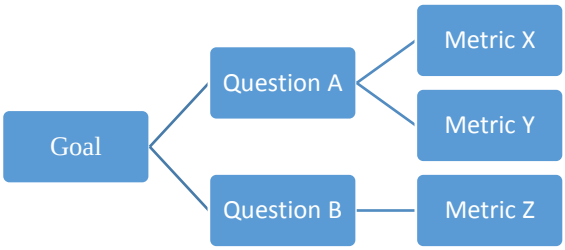

Fig. 2 Goal – Question – Metric process

GQM is not an answer for all the questions composing KPI with the "Top-down" approach. For example: goal like "Increase sensitive information transfer security." leads to question like: "How much sensitive information are we transferring for a period of time?", and to metric like: "Transfer rate of sensitive information [Gigabytes/day]".

Everting looks fine and the metric is ready, however there are important things missing. It is a common mistake starting with goal like this one. Goals should be decision supportive entity and not a conclusion itself (to "increase the security…"). The starting point here should be "Do we need to increase sensitive information transfer security?" (probably "yes"). There may have been a question before that; something like, "Do we have significant concentration of risk associated with sensitive information transfers?" (Again, probably "yes"). Absent the context of those questions and defining a metric like "transfer rate of sensitive information" might be leading to wrong conclusions even though the result is sufficient metric definition.

In the example above related to information transfer, the question was phrased as "how much…?" instead of "Do we need…?" and "Do we have…?" which should be the first two

question aligned with decision-making process forming real goals. Understanding the decision context is important part before going forward. One more thing should be mentioned here—comparison. Aiming of metrics creation is with only one reason - comparisons between, for example:

- Current conditions and desired conditions;
- Past conditions and current conditions;
- Past conditions and desired conditions.

As a different perspective of GQM process the Information Security Forum (ISF) form their own stepwise approach [6]. It was designed to be applied at all levels of an organization and consists of four phases:

- Establish relevance by engaging to understand the business context, identify common interests and develop combinations of KPIs;
- Generate insights by engaging to produce, calibrate and interpret KPI combinations;
- Create impact by engaging to make recommendations relating to common interests and make decisions about next steps;
- Learn and improve by engaging to develop learning and improvement plans.

3. "Bottom-up" method

"Bottom-up" is an alternative approach [7] which starts form the data collected. The method relies on indexes for which sufficient information is obtained. Based on these indexes suitable KPIs are built in order to meet the business requirements. Better results are achieved if this method is repeated several times. The main advantage, this method has, is that aligning KPIs with the collected data means that the result will be calculable.

There are two disadvantages to this approach:

- Potential gap between management expectations and KPIs.
- Risk that KPIs provide information mostly on an operational level, and insufficiently on strategic levels for higher management.

4. Hybrid method ("Top-down" and "Bottom-up")

In real situation mixed approach will give better results. The Goal-Question-Metric (GQM) process is a good way to develop security metrics that are targeted to specific needs, and it takes into account the unique requirements of a particular organization or environment. But it can also be useful to have a set of predeveloped metrics that can be used right away. Most organizations will already have security metrics that they collect and analyze [5].

In PROS 10/10: Guideline 3: Key Performance Indicators are mentioned few others KPI development methods: Lifecycle Approach, Risk Based, Cause & Effect.

5. Lifecycle Approach

KPIs is developed using the organization services lifecycle. KPIs could be developed for each life cycle stage. The use of a lifecycle approach to developing KPIs would ensure a company takes into account KPIs at all stages of the processes. Each stage could also be considered a lifecycle in its own right and appropriate KPIs developed.

Most of the time these are low level KPIs formed as a checklist. For example: % of material waste during production or % of defective products etc.

6. Risk Based

The risk based approach identifies those specific services, functions or activities that may have a negative or harmful impact on the organization. In general terms, there are a

number of methods for identifying risk and these normally have two parameters:

- Likelihood/probability of a risk occurring, and
- The impact of a risk occurring.

By identifying areas of risk, KPIs could be used to measure progress towards mitigating the risk.

Example:

Compromise of sensitive documents

KPI – result in % loss (based of 100% internal audit twice a year)

7. Cause & Effect

A suggested approach is to examine specific areas of concern using the cause and effect technique. The cause and effect technique might assist with identification of KPIs to address the fundamental or underlying cause of ineffective or inefficient services, functions or activities. The approach analyses the cause(s) and identifies KPIs that address the effect. By addressing the effect, improvements can generally be achieved.

Example:

Cause - slow delivery of mail correspondence

KPI - % delivery within a day

8. Conclusion

There are many approaches to create appropriate KPIs, this is not closed list. Organizations often identify approaches that are most relevant to their unique business outcomes and activities. The main goal however is to build a certain level of information security on top of measurable KPIs which should lead the organization in the right direction. Combining different approach will give a different perspective to the same objectives and will bring more accurate results.

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Developing Key Performance Indicators for Assessing Information Security of University Business Processes

Veliko Ivanov

University of National and World Economy, Sofia, Bulgaria
velikoivanov@unwe.bg

Abstract. The paper presents the necessity of developing a set of Key Performance Indicators (KPI) for information security assessment in the university processes. Key university business processes are analyzed. Proper key indicators are given as an example to provide an adequate information security assessment.

Keywords. Key performance indicators, Information security, University business processes.

1. Introduction

Information security does not directly bring financial results and this makes it difficult to evaluate the costs. This is one of the reasons to be developed specific key performance indicators (KPI), to help in assessing security processes and to clarify whether and what more could be done to protect the core university processes.

One of the most widely used definitions of Information Security provides standard ISO-27000 [1]: preservation of confidentiality, integrity and availability of information. In addition, other properties, such as authenticity, accountability, non-repudiation, and reliability can also be involved.

The paper will start with a brief overview of security processes and mechanisms, which will be the basis for setting up KPIs then it will continue with KPI building process.

2. Features of University Business Processes

There are many KPI [2] developed for specific purposes, but in context of university business processes most of them either cannot be applied on or the results after evaluation stays unclear in terms of information security. The reason for that is hidden in the features of university business processes:

- Most of these processes cannot be measured in financial terms;
- Most processes are seasonal;
- There are processes with complicated structure and a large number of participants;
- There are processes that do not use information systems or do not collected enough data to correctly calculate a key indicator.

This in turn leads to problems in the development of KPIs that can be summarized as:

- Difficulties in defining and setting reference values which are explaining the KPI results (How should we interpret indicator - Ten infected computers per year?);
- The interpretation of measurements in percentage often are subjective (What is 75 percent fault tolerance?);
- All kind of assessments in financial terms are compromised by default;
- Difficulty using indicators based on short intervals monitoring;

– Problems creating generalized KPI using large amounts of accumulated data calculation.

Consideration of various methods [3][4] for setting up KPIs, and the above information, leads to the conclusion that suitable in the case of evaluating the security of university business processes is "Bottom-up" [4]. The tasks that follows are:

– Exploring the low-level data collected;
– Structure configuration and index creation.

3. Information Security Services and Mechanisms

Starting KPI building process, it is needed to be formed a connection/grid between information security characteristics and mechanisms. This way it will be easier to define operative KPI based on the low-level security mechanisms which are implemented already.

In his work Stewart Jacobs [5] examined the characteristics of information security as security services, linking their implementation with specific protection mechanisms.

In terms of history first were formed following five basic security services: authentication (access control), authorization, data integrity, confidentiality and non-repudiation. With ISO 27000[1][6] family standards appearance, it should be added and revised: authentication, authorization, integrity, availability, accountability, non-repudiation:

– Confidentiality:
  • connection confidentiality;
  • connectionless confidentiality;
  • selective field confidentiality;
  • traffic flow confidentiality.
– Integrity:
  • information integrity;
  • separation of duty;
  • Well-formed transactions;
  • Data Integrity – includes: connection integrity with recovery; connection integrity without recovery; selective field connection integrity; connectionless integrity; selective field connectionless integrity.
– Availability:
  • Prevention of service access denial (DoS);
  • Prevention of service failure;
  • Restoration/continuity of services.
– Accountability:
  • Logging and auditing;
  • Non-repudiation with proof of origin;
  • Non-repudiation with proof of delivery.
– Authentication and authorization:
  • Peer-entity authentication in communication;
  • Data-origin authentication;
  • User authentication;
  • Access Control.

Each of these security services is achieved with the implementation of specific security mechanisms. Security mechanisms are listed below (it is not a closed list). Each of these mechanisms may contribute to more than one process:

– Symmetric encryption;
– Asymmetric encryption;
– Access Control lists;

- Access control bits;
- User passwords;
- Security tokens;
- Digital Signatures;
- Biometrics attributes;
- Authentication Protocols;
- Data integrity mechanisms;
- Traffic padding;
- Routing controls;
- Nonce—time stamps;
- Packages filtering;
- Packages inspection;
- Verification of Application gateway.

The following table display the relationship between security processes and the reviewed mechanisms (Table 1).

For proper KPI design it is necessary to go through the following steps:

- Selecting object, which will be measured;
- Selecting a characteristic of the object, which can be measured with accurate, clear and understandable values;
- Values that could be measured - momentary and in a period;
- Construction of scale for accurate measurement of KPI - the most commonly used time, percentage or financial measures;
- Making an exact distinction of all values that KPI can be equal to;
- Analysis or conclusion should be possible based on the KPI values.

4. KPI-1 Availability

To evaluate all major characteristics of information security in university business processes, it could be used at least one well-known indicator, to measure "Availability". Example is highlighted below:

KPI-1 (Availability) = [MTBF / (MTBF + MTTR)] x100 [7]

MTBF - mean time between failure
MTTR - mean time to repair.

5. KPI-2 Level of Authentication and Access Control (LAaAC)

Using the logical connection between first four columns (in Table 1) a KPI could be created to measure the security level authentication and access control. Each mechanism that could be implemented in order to receive better results for the information system security is marked with "tick". The total number of marked cells in the first four columns is 21, but since symmetric and asymmetric encryption are interchangeable security mechanisms, KPI scale is not from 0 to 21, but from 0 to 19, where 0 - unprotected, and 19 - a high level of protection. This scale may evolve in the future with adding new security mechanisms which will leads to higher upper limit.

6. KPI-3 Level of Assurance (LA)

Looking back Table 1, it can be created another interesting indicator - level of assurance. Reviewing columns 5, 6, 7 (related to categories confidentiality and integrity), using the way KPI-2 was created, KPI-3 could be built with focus on the business processes data

flow reliability. This way KPI-3 is able to determined level of assurance of heterogeneous processes:

- Transactions credibility;
- Reliability of data and information.

KPI-3 scale range is from 0 to 11 where 0 means low level of assurance, and 11 - high level of assurance

Table 1 relationship between information security services and mechanisms

Services / Processes	Peer-entity auth. in communication	Data-origin auth.	User auth.	Access Control	Confidentiality	Info. Integrity	Data integrity	Prevention of DoS	Prevention of service faihure	Restoration/ continuity of services	Logging and auditing	Non-repudiation with proof of origin	Non-repudiation with proof of delivery
Symmetric encryption		√		√	√		√						
Asymmetric encryption	√	√		√	√		√					√	√
Access Control lists				√		√	√	√			√		
Access control bits				√			√				√		
User passwords			√	√									
Security token			√	√									
Digital Signatures	√		√	√			√					√	√
Biometrics attributes			√	√									
Authentication Protocols			√	√									
Data integrity mechanisms							√				√		
Traffic padding					√								
Routing controls								√		√			
Time stamps						√					√		
Packages filtering				√				√					
Packages inspection				√				√					
Verification of App. GW				√				√					

7. KPI-4 Accountability and Responsibility (AaR)

Another interesting indicator (level of accountability and responsibility) is build based on columns 11, 12, 13 of Table 1. Columns 11, 12, 13 are related to the categories of audit, accountability and responsibility. KPI-4 is focused on the possibility of proving responsibilities in any part (task/activity) of the business processes. This indicator is of great importance as it measures the assessment of basic characteristics of information security. Scale range is from 0 to 8 where 0 - inability to prove responsibility, and 8 - an indication of correctly identified responsibilities in any part of the business processes.

So these four indicators would provide a good basis for assessing the security of university business processes. Also, by designing a mechanism to evaluate the second, third and fourth indicators it is shown a direction for progressing in order to enhance information security of university business processes.

8. Conclusion

Evaluating core university business processes is key step of increasing information security. Searching in the field of already existing KPI is good approach but it is not enough. Combining KPI research and creating KPI is the ultimate approach not only for university, but

for every organization assessment. The presented service/mechanisms mode is clearly not only for university information security evaluation, however taking into account the specifics of university processes will be a turning point for creating helpful KPIs in this area.

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