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FOREWORD

Conference on Information Technology for Practice 2016

Welcome to the 19th "Information Technology for Practice", the conference with international participation, held at Faculty of Economics VŠB-Technical University Ostrava.

We are very pleased by the interest of domestic and foreign participants at the conference.

Thanks to our partners from EUNIS-CZ for its long support, inspiration and active participation in the conference. thanks also to CSSI, providing patronage of the conference. We also thank to Engliš Foundation, which facilitate the organization of the event.

Our thanks belong also to the heads of EkF VŠB-TU Ostrava and to our colleagues from Department of Applied Informatics for their effort and time devoted to the organizing of the conference.

In accordance with development in society and dynamic development of information technologies, this year's conference is focused on the following topics:

- IT Management and IT Services
- Process Management
- Information Security
- Information Society a IT Education
- IT Innovation in Enterprises

The increasing interest of authors to present their results on conference shows that twenty years of our work to create a platform for exchange of information among academic sphere, IT developers and users gives fruits.

On behalf of organizers,

Milena Tvrdíková October 2016

C O N T E N T S

IT MANAGEMENT AND IT SERVICES

Satisfaction by Enterprise Software Support in SMEs of Kazakhstan

Azamatov Bakhytzhan[1]

Abstract. The main objective of the current study is to assess the satisfaction of the users with the enterprise software in the small and medium enterprises (SMEs) in Kazakhstan. To make this assessment 55 organizations, which are using 77 Types of enterprise software were interviewed. The sample was randomly selected according to the representativeness of each industry in the economy. The respondents were divided into two Groups: Group A - the managers and Group B – the ordinary employees. Each Group has been asked to rate their satisfaction with the enterprise software by answering to three prepared questions, which are an additional part of the main questionnaire. Additionally, organizations were divided into three Groups according to their service support Types.
One of the preliminary findings of the current study has shown significant results variation between two Groups in one of the three Types of software support. However, despite the fact of some variation of the rates provided by two Groups, statistically this difference is considered to be not significant for the three Types of support.

Keywords: Software support, Software satisfaction, Enterprise software, SME.

JEL Classification: L15, L86

1 Introduction

Kazakhstan is the one of the leaders of economic growth among the Common wealth of Independent States (CIS) countries. For many years government of Kazakhstan upholds that private sector is essential for economic development. There is rapid development of enterprises in Kazakhstan, however the last years they face new challenges in economic field. During the last year the economy of Kazakhstan was significantly impacted by lower commodities prices, a deep recession in Russia, and harsh financial conditions (Focus Economics, 2016). For many local companies actual task is reduction of costs to different services including IT support service.

The recent devaluation of the national currency in Kazakhstan had greatly affected the financial state of many companies. Therefore, most

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companies are looking for a different ways to reduce their expenditures and improve financial balance; one of the ways would be optimization of the company's information systems. It is studied, that companies which constantly need an IT support can seriously disrupt their business processes in case of reduction the information systems expenditures.

2 SME definition

The SMEs have an important role for a country's economy all over the world as to their contribution to the total output and job opportunities (Gunasekaran, 1999).

The term "SME" encompasses a broad variety of definitions. Different countries and organizations give different definitions to SMEs, they often based on number of employees, sales or assets. European Commission defines SMEs as enterprises with 50-250 employees, $10-50 million in annual income and $10-43 million in assets(European Comission, 2003). Determination of the status of the small and medium-sized businesses in Kazakhstan is based on the Entrepreneurial Codex of the Republic of Kazakhstan (Government of Kazakhstan, 2016). Kazakhstan defines medium-sized entities as enterprises with €2.4 million assets and 250 employees. Small entities are €0.4 million in assets and 50 employees and both criteria above should exceed the limit (Government of Kazakhstan, 2016).

3 Software support

3.1 Maintenance

While external sources of software and maintenance present other possible and potentially economical alternatives for organizations, choosing the best alternative is an easy decision process which must be understood and supported. As application acquisition and maintenance constitute a majority of the present-day IT budget of most organizations application sourcing and maintenance decisions have to be thoroughly studied. In some cases software maintenance can reach 60% of organization's IT budget(Middlemiss, 2004).

According to IEEE software maintenance is the process of modifying a software system or component after delivery to correct faults, improve performances or other elements, or accustom to a changed environment(IEEE,

1990). Maintenance plays an important role in the life cycle of a software product(ISO/IEC-12207, 1995). There are four Types of maintenance: corrective, adaptive, perfective, and preventive(Lientz, 1980). Adaptive maintenance encompasses the changes needed as a result of some change in the environment in which the system must operate, for instance, altering a system to make it working on another hardware platform, operating system, DBMS, TP monitor, or network. Finally, perfective maintenance depends on users' requests; examples include inserting, deleting, extending, and modifying functions, improving performances, or improving ease of use(Lientz, 1980). Pigoski suggests enhancements as putting together the adaptive and perfective categories, as these Types of changes are improvements (Pigoski, 1997).

3.2 IT Outsourcing

Several empirical studies have identified the reasons for outsourcing. These include a closer focus on the core business, rapid introduction of new products, cost reduction, improved access to technical skill, and the lack of required resources or expertise to develop internally(Jens Dibbern, 2004). Outsourcing refers to the practice of transferring business activities of a firm to a third party vendor either within the country or outside the country so that the firm can concentrate on its core business. (RudyHirschheim, 2014). IS outsourcing can be defined as "the practice of turning over part or all of an organization's IS functions to external service provider(s)"(Grover, 1996).

Two Types of outsourcing can exist. Partial – when only a few parts of the software system are contracted. Complete - when the whole software system under development is contracted. Another classification the outsourcing can be planned or ad hoc(Kavčič, 2014). The planned outsourcing is a part of company strategic business plan. The ad-hoc outsourcing can help with solving unexpected software problems.

4 Data & Research Methodology

This research was conducted by applying questionnaire with 4 main questions using 5 point scale. The main objective was to find out the satisfaction by Types of support services. The survey took place on March 2016.

The questionnaire was spread to 55 organizations with the 77 Type of software. The following method was used: finding respondents via public company database on the Internet and conducting a survey via telephone. Three indicators were evaluated by the respondents: satisfaction by software, understanding the software, efficiency of the software. Three Types of support were considered. The first where enterprises have IT department or person in charge and the users take the support continuously. The second Type which calls IT-outsourcing is the organization with external IT support where they have the state contract with external IT support Company. Third Type is the enterprise which also can have external support, but does not have defined IT support organization or persons in charge. They pay their bills only when issues occur. To study research findings, the statistical analysis such as t-test and ANOVA test were applied.

5 Industries selected to carry out the survey

Public sources of information, including the Internet were used in selection procedure of enterprises. Enterprises were selected randomly according to their share in the industries from the statistical data of KazSTAT (Ministry of National Economy of Kazakhstan, 2016).

The survey was focused on 55 organizations that work in different industries. The surveyed organizations were categorized into three Types and two Groups.

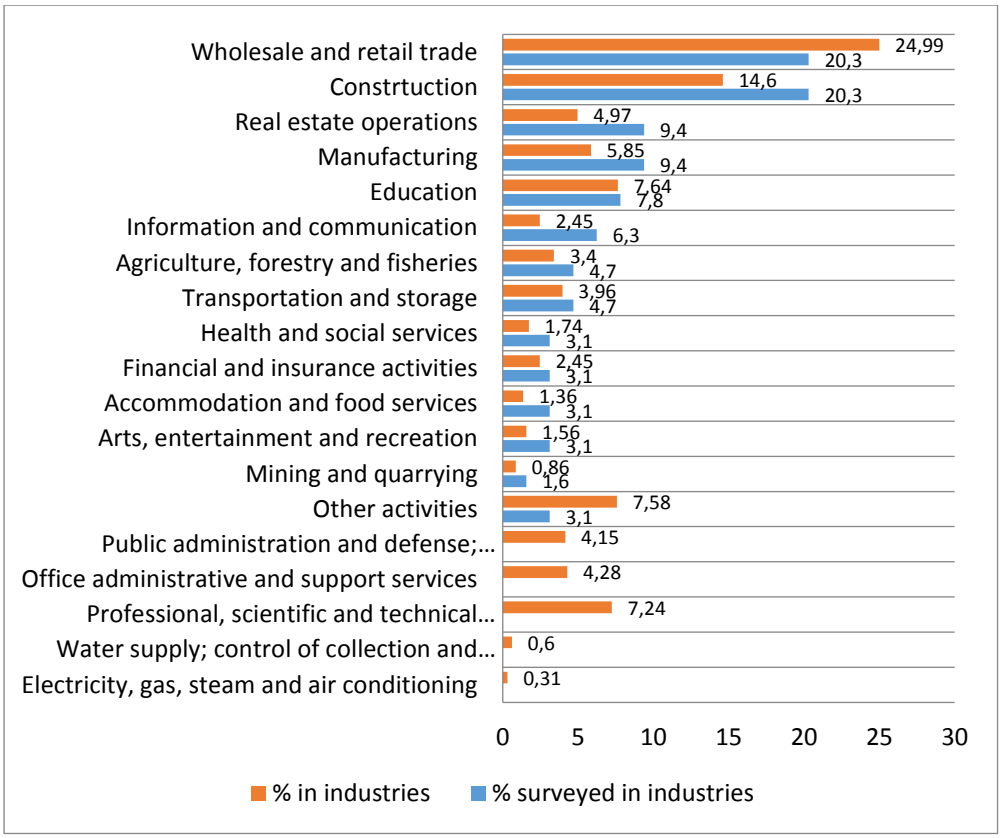

Figure 1 Number of surveyed respondents related to industries, Source: own.

6 Data tables

In the table below the respondents are categorized by Types of software support services. Despite the fact that enterprises were chosen randomly, the distribution of organizations by support Type turned up to be almost the same. The number of software decreases from Type X to the Type Z. This is due to the size of the companies. The majority of the respondents of Type Z are small enterprises, whereas the Type X dominated by medium-sized enterprises (Table 1).

Table 1 Types of software support, Source: own.

Types	Description	Number of organizations	Number of software
Type X	With IT department or person in charge	18	31
Type Y	With contract of external support	19	27
Type Z	With not defined IT support	18	21

The number of people in Group B is more than the number of people Group A, because usually number of managers in the companies is less than employees (Table 2).

Table 2 Groups of surveyed, Source: own.

	Description	Number of surveyed
Croup A	Managers	19
Group B	Employees	35

The means for all analyzed indicators: satisfaction by software, understanding the software, efficiency of the software show higher results for Group A (Table 3).

Table 3 Results of Type X, Source: own.

	Group A Mean	Group B Mean
Satisfaction by software	4.31	4.06
Understanding the software	4,38	4,19
Efficiency of the software	4,31	4,13
	4,33	4,13

For the Type Y satisfaction by software the Group B showed the higher result. The other two indicators are turned out to be the highly rated by Group A (Table 4).

Table 4 Results of Type Y, Source: own.

	Group A Mean	Group B Mean
Satisfaction by software	4,10	4,12
Understanding the software	4,10	3,94
Efficiency of the software	4,20	4,06
	4,13	4,04

The third Type Z software support for Group B has showed the lowest rate for “Understanding the software” indicator (Table 5).

Table 5 Results of Type Z, Source: own.

	Group A Mean	Group B Mean
Satisfaction by software	4,17	4,13
Understanding the software	4	3,87
Efficiency of the software	4,17	4,07
	4,11	4,02

According to the t-test the Type X has significant difference between two Groups. As for other two Types there was no significant difference obtained. Summarized t-tests and p-values are shown in the Table 6.

Table 6 The result of t-test for Group A and B, Source: own.

	T-statistics	P-value	Results
Type X	4,706789709	0,00926168	Significant
Type Y	1,52699788	0,22420248	Not significant
Type Z	0,911857756	0,413428047	Not significant

The ANOVA test for the means of the three Types of software support (X, Y, and Z) is not statistically significant.

Table 7 ANOVA of Three Types, Source: own.

F Value	F Critical	P-value
1,57	9,55	0,34167687

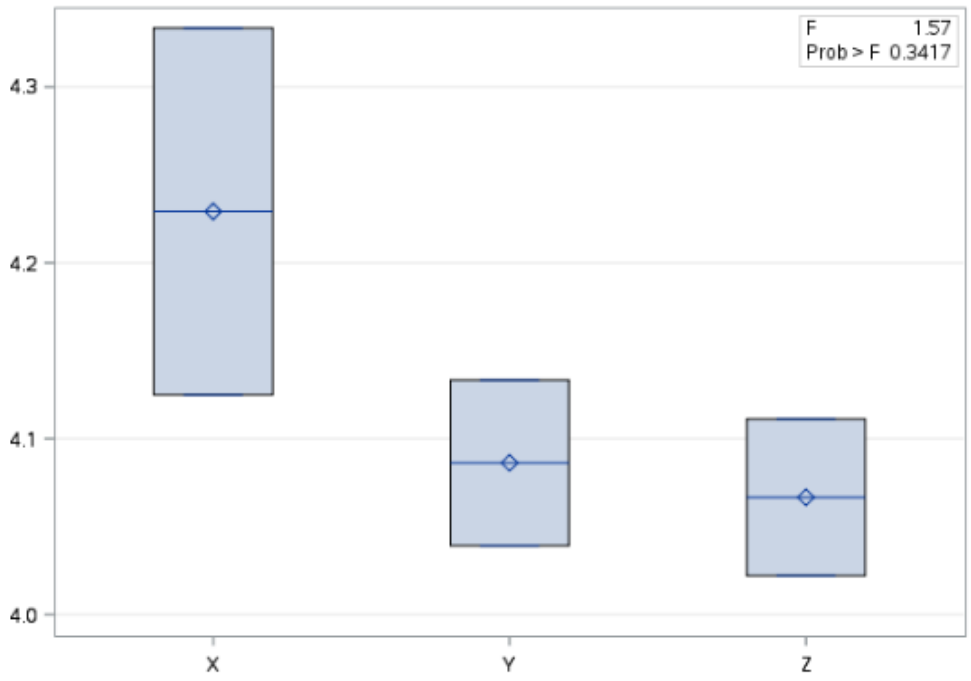

Figure 2 Comparison of three Types of support, Source: own.

In the Figure 2 we can see that Type X has wider evaluation variations and higher rates than other two. Also it can be seen from the Figure 2 that Y and Z Types of support have close rating levels.

7 Analysis of the survey

All of the organizations were selected randomly and it shows the proportions of enterprises of three Types of IT support service are about the same. It can be seen from the results of the survey that the difference between three Types of support services is not significant.

Despite the overall high ratings for the Type X, the managers (Group A) performed significantly higher rating than the employees (Group B), this is also confirmed by the t-test results. One of the explanations can be their decision making position in the software procurement process. Also the managers have a main role in selection of the Type of support service.

The Type X software support, with IT department or person in charge, has the highest rate among the other Types. This represents the fact that company's staff has regular access to the IT professionals and can receive their assistance at any time without breaking the daily workload, which contributes to higher productivity and better work performance.

The almost similar rating for Types Y and Z explains that there is no significant difference either company has a defined outsourcing IT contract or receives just a random external IT support. The only deviation in results for these two Types may occur because Type Z software support mainly consists of small enterprises, whereas Type Y is representing more medium-sized enterprises.

Overall, it can be observed that almost all respondents were satisfied with their software. There were only few respondents who rated the statements bellow three out of five.

8 Summary and conclusion

The devaluation which recently happened in Kazakhstan greatly reduced financial capabilities of many companies. At the moment, with the onset of problems in the economy of Kazakhstan many companies are looking for a way to reduce costs. The survey shows that the assessment of the difference between the internal, external and not defined software support is generally not large. Though, among three types of support those organizations with ongoing support are more satisfied. Surely, the use of internal IT support implies them to spend more money than the respondents with no permanent support.

This study can assist small and medium enterprises in determining to what kind of support service, they may prefer. The main point in the choice of the Type of support software is the cost. Also for some companies because of their size and the rare use of software applications there is no need for constant support of their applications. Correctly selected type of support can help a company find a balance between cost and quality. It should be understood that in some cases, in the pursuit of savings may suffer quality of work. Companies that constantly need support can seriously disrupt their business processes trying to reduce costs through savings in IT maintain.

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Service Management in Multinational Corporations

Ivana Cigánková[1], Radan Seidler[2]

Abstract. IT Management and IT Services in multinational corporations. Presentation of the service management policy for the area of information and communication technologies (ICT) in the environment of the largest logistics corporation, and the practical experience of the application of the theoretical principles in the real environment.

Keywords: 4-6 keywords, Information and telecommunication technologies, Service Level Agreement, Life cycle of ICT services, Business Contingency/Disaster Recovery Plans, External vendor maintenance.

JEL Classification: M15

1 The definition of service management according to DHL internal rules

The main role of Service Management is the management of ICT services, delivered by external and internal providers. In a contract concluded between the provider and consumer of ICT services are criteria supplied services and the rights and obligations of the consumer and the provider of the service.

From the perspective of the company, the costs are one of the most important aspects. Therefore, whether the resources correspond to the supplied service and its quality (Bernard and Chittenden, 2012). We divide costs into BUILD and RUN in the DHL. Build costs are those that the company will pay for the introduction of services, this is a one-off cost, and most of the necessary investment. The service is also possible to buy without these build costs, which shall be covered by the provider. Run costs are the costs that the company pays for the service provided, and usually it is the costs to be paid on a monthly basis, only in exceptional cases on an annual basis. Both costs are monitored and evaluated (Ebel, 2012). Benchmarking is applied in such cases. Build costs are evaluated and undergo a special approval process prior to their spending, run cost is usually evaluated on an annual basis. In addition, IT cost/revenue is

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tracked for the evaluation of the ITC costs to avoid ICT costs oscillation within the company.

Another equally important aspect is the quality. Quality of delivered services in DHL we follow by using metrics. We use both kinds of metrics called hard, which includes the measurement of availability and performance services and so called soft, which includes the reporting of user satisfaction.

In hard metrics the most proven are these measurements:

- The measurement of service availability and performance by simulating the end-user experience (transactions).
- Measurement (reporting) solution requirements.

Soft metrics - these measurement:

- The satisfaction of users with the ICT-quarterly.
- Evaluation of service desk – usually after making a call or demand.

In recent years, it is obvious that for ICT services, which depends significantly on the core business, Business Contingency Plans (BCP)/Disaster Recovery Plans (DRP) are prepared. This is instructions on what to do when the ICT service is unavailable for an extended period (Hunka and Ministr, 2013). In DHL, this is the replacement procedures, not to jeopardize the business. The BCP involves people from the IT and the business (end users) and, where it makes sense, providers of ICT services. DRP are suppliers of ICT services (Ministr, 2013).

It is a matter of course, that the rules are implemented in the DHL ITIL (Axelos, 2013) in ICT schemes for individual ICT services, with a focus on the individual segments of the business operations that are supported by means of ICT. The ITIL processes and service desk function are described in greater detail in the chapter 3.

For compliance with internal policies (compliance management) for the use of ICT resources and to avoid damage when misuse, malfunction or incidents having a direct or indirect impact on the core business is in DHL introduced the so-called Crisp (Controls and Risk International Standardization Platform). CRISP is a framework that is in DHL used to check compliance with legal requirements, to increase transparency and risk management, as well as to identify and remedy any identified deficiencies.

This is a self-assessment in a formalized and documented way, in several areas, one of which is the ICT.

Last but not least is in DHL implemented security management and compliance monitoring employees, customers and suppliers.

Security management concerns in particular:

- protection of personal data,
- protection of sensitive corporate data.

For employees, this is the regular training and regular checks of the approaches to information so that each had only such approaches to data that is essential to his work (Motschnik et all., 2014). Customers are approaches to information laid down by contract including confidentiality declaration.

2 Universal access to allocations of IT and communication costs among business units

The DHL group is a multinational company with global, regional and local management, determining the rules. There is defined the corporate universal reporting tool named CREST (Corporate Reporting Statement), which is used by all DHL legal entities and their business units as mandatory. The reporting due date is defined for the 5th working day in the next month, but some parts (vendor costs or cost accruals) should be prepared by the 2nd working day.

ICT services are internally provided by group units to other units of the group on the basis of the proposed and agreed SLA (Service Level Agreement). The units can be either defined as legal entities and the performances are recharged among accounting entities (3rd party posting), or they are business units (divisional determining) together forming one legal entity, then the costs are relocated only according to the rules of the internal (in-house) accounting in the controlling statements.

The Corporation uses a single, global reporting system CREST, each business unit has assigned a separate CREST code (unit key) regardless of its legal entity and status within it. Costs and revenues are allocated through the CREST codes or in greater detail through cost centers. Some performances of the central services are allocated to business units only through this CREST reporting, i.e. their evaluation is not performed through an accounting

statement of revenues and expenses, but only through internal CREST statements (managerial level of the financial perspective).

In the case more business units share performance of external suppliers followed by the reallocation of external costs according to agreed internal drivers follows. In the case of significant abnormalities of real costs against the planned cost, their revaluation, so called true-up is implemented. Therefore, the allocation may change even during the agreed period (e.g. during the accounting year).

In case of external provider costs, the invoiced working activities are either ordered and invoiced separately (a previous conclusion is necessary due coordination of purchase ordering process), more frequent procedure is defined for one business unit, which orders the full order and sent it to the vendor, all external costs are later reallocated using the concluded keys and recharged among business units.

3 Life cycle of ICT services

The life cycle of ICT services is made up of processes:

- Competitions
- Negotiate the SLA
- Change Management
- Incident and Problem Management
- Review of the services provided (named Service Review)
- Termination of obligations and services

3.1 Selection procedures (tenders)

Competitions are held in the DHL so that the company has signed the contract for the ICT service provider with the best possible, not only the price, but also the quality of the service provided, is assessed (Oškrdal and Doucek, 2014). For each provider it is also its reliability, and whether it complies with the Code of Ethics of DHL.

3.2 SLA Negotiation

SLA are discussed at great length in DHL. It is important to establish the optimal value of availability and performance services and also, what and how will be measured, and what and how to report and evaluate. It is beneficial to

further describe in detail how it will run incident and problem resolution, how and under what conditions the changes will be implemented.

3.3 Change Management

Change management must be formalised and documented process. In principle, the change occurs for two main reasons. As necessary to the solution of the incident or problem and as a fulfillment of the requirement of the business. If it is possible, so any change should be carefully tested before deployment, and in any case must be documented (Ministr and Pitner, 2016). Changes are to be approved by CAB (Change Advisory Board).

The standard changes form a special group defined in the catalogue of standard changes, while the CAB is approved prior to inclusion in this catalog. Changes are implemented according to the conditions listed in the catalog.

3.4 Incident and Problem Management

Incident management settings is one of the most important things for the functioning of the services. In case of unavailability or deterioration in performance of the service, you must have set the rules for:

- the method of reporting the incident (in DHL is by telephone by contacting the IT service desk and through a dedicated tools-application)
- the rate of solution of incidents according to their extend and severity (in DHL, incidents are divided into groups, each of which has the solution fixed time)
- confirmation of the resolution of the incident by the business
- reporting and additional corrective measures, in order to avoid the recurrence of incidents

3.5 Review of the services provided

To check the level of the services provided is used for regular service review. This is usually a meeting with a representative of the service provider, which is evaluated:

- the availability and performance of the services according to the agreed measurement and reporting

- the number and duration of incidents, their way of solution and any corrective action
- solutions to other requirements, such as changes
- satisfaction with the performance of service desk

3.6 Their obligations, termination of services

The use of the services is done according to the rules agreed in the SLA or other contract. When stopping services count with agreed notice period, possibly with other commitments.

The life cycle of ICT services is supported by features:

- Service Desk ("call center" for ICT)
- Service Delivery Manager
- Service Owner
- Key Account Manager

3.7 Service Desk

The service desk is also called the "single point of contact" for service users and requirements for incident reporting. It is desirable that the agents/service desk analysts had the awareness about which services are critical to the business and which are more or less important. Communication with the service desk in the DHL takes place in two ways:

- by phone
- exposure to the so-called ticket (for a given request)

Service desk performs the following basic tasks:

- as a contact for the user finds relevant information for the solution of the request
- where appropriate, the request logs (if it not registered by the user) and it will resolve itself or assigns solution group
- supervises the solution request

3.8 Service Delivery Manager

It is the role of the service provider. Service Delivery Manager's main task is to monitor and ensure the quality of delivered services.

3.9 Service Owner

This is the role at the side of the business. Service Owner communicates with the service provider, is negotiating and approving the changes, monitors the quality of delivered services and, where appropriate, calls for corrective action.

3.10 Key Account Manager

This is the role of the service provider. Key Account Manager, negotiating SLAs, monitors the satisfaction of users and proposes changes to the quality of service delivered to optimally meet their requirements.

4 External suppliers control (management)

Most of all services are provided by external vendors. These vendors are represented not only as the 3rd party, but there is about the other DHL partners strictly divorced in the form of external legal entity.

There are two views for maintenance of vendors:

1. Formal assessment of external vendors.
2. Technical preparations for tenders.

If there is necessary to contact new vendor, the first step is made by the Procurement department. There is necessary to evaluate the vendor position in the market, the bid assumptions, the possible benchmarking. This procedure is usually based on the tender initialization, preparation, negotiation and conclusion of formal contract. For the contracts, at least 3 potential vendors are approached by Procurement pro-actively. The tender process is maintained as the same or similar as in other companies, the multi-criteria analysis is defined in collaboration of all concerned departments, where the technical assumptions for IT features are defined by Business IT department.

Procurement department is responsible to supervise the selected contract, which is defined for the continual evaluating in the next periods. Usually for the contracts with higher amounts of budget. There is necessary to make the proposals for changing prices and recurring permanent benchmarking to get the best service at the optimal costs. Changing the payment terms and conditions according to the current situation.

Procurement department is guarantee for all formal processes including the negotiation for accepting the DHL general rules: compliance statements,

internal codes, as well as all legal requirements as well (safety and health protection during work, fire protection, protection of personal data etc.).

Service management ICT is responsible for technical preparation for tenders, participation in tenders as the expert, where is necessary to make an assessment of tenders in terms of professional competence and compatibility with DHL ICT standards defined on the global or regional levels.

Special role is defined for monitoring the life cycle of ICT services after providing solution. All servers, printer devices, network properties and equipment owned by DHL are necessary to control for the living cycles. And to propose the replacing plans in sufficient advance regarding the rules and budget forecasting. For some important properties used in the lease, or as an external paid service, there is a collaboration in this process negotiated with the vendor as well.

Using the external service, there is necessary to evaluate the build/run costs permanently. All costs defined in the fix price are under responsibility of vendor, but ICT needs to check the relevant delivered working activities, if their quality and amount are suitable with the open conditions. Material based contracts are maintained in other mode: All working activities are separated into defined packages, evaluated for the first price quotation and then monitored for the full-filling. The extra works should be defined before closing all packages and approved before delivery. There are two models of cost maintenance: Open book, where each activity must be approved at first and the margins for suppliers are strictly fixed, or there is the quotation for working hours and costs with the max amount of working hours, where all hours for extra works are not usually paid due the bad estimates of vendor.

The special problem is defined for causes, where there is not possible to nominate only one general vendor with itself managed subcontractors. For example, the collaboration for changes in the ERP systems, where the DHL IT Services as the general organization for server support needs to collaborate with ERP Business Partner engaged for special services, which was ensured by ICT department directly. The role of ICT is defined not only on the cost and expert base, but as a mediator and working coordinator for all affected parties.

5 Conclusion

Service management for ICT services is very sophisticated process and approach in the multinational corporations. There are a lot of staff members with high specialization for these operations. Global and regional rules are defined very strictly and there is necessary to strictly adhere to the rules and conduct self-assessment on the regular basis. Such activities are not generating profits, but reduce the cost of poor.

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Project Resource Allocation in Conditions of Ambiguity

Martin Pelikán, Hana Štiková, Ivan Vrana [1]

Abstract. Planning of project resource allocation often suffers from uncertainty and ambiguity, which can be described by the theory of fuzzy sets. In this presentation, besides the project duration monitoring and the critical path setting, we also focus on utilization of the fuzzy theory to the planning of resource allocation and monitoring of resource workloads. We shall outline theoretical relations for the membership functions of the relevant fuzzy quantities and illustrate application of the method by an example project. We shall also show advantages of the fuzzy approach in the project resource scheduling and demonstrate that fuzzy approach is superior to the deterministic approach.

Keywords: Resource allocation, Project management, Fuzzy approach

1 Introduction and motivation

The planning and management of human and material resources plays an important role in the success of a project. Predictions for the risks associated with the allocation of people or equipment simultaneously to several project activities can improve achievability of project goals (e Silva and Costa [5]). Reliable resource management can bring strategic competitive advantage (Huemann et al. [11]). Uncertainty and ambiguity accompany each project and due to the uniqueness of each project, it is often impossible to use statistical methods to handle this uncertainty because of lack of statistical data leading to the correct choice of an adequate statistical model. In such cases, the methods based on a fuzzy set theory offer an appropriate alternative (e.g. Dubois and Prade [4], Zadeh [36]).

Researchers used the fuzzy approach in searching for effective methods and solutions, but the examined procedures for the complex project management that emerged not easy to solve and many related problems are NP-hard. Zimmermann [40] introduced fuzzy programming techniques into linear programming and confirmed that an equivalent crisp linear programming problem exists following the fuzzy decision-making concept of

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Bellman and Zadeh [1]. Some authors used linear programming methods to solve problems concerning project duration time and similar tasks (e.g. Chanas and Zieliński [2], Dubois et al. [3], Ghazanfari et al. [6], Kumar and Kaur [14], Usha Madhuri et al. [29]), Mjelde [21], Hussein and Abo-Sinna [10], Wang and Fu [31], Wang and Liang [32], Mukherjee and Kajla [22], Shahsavari et al. [25], Leu et al. [15], Zheng et al. [39], Jin et al. [12], Ke and Liu [13], Zhang et al. [38], Li and Dai [16] Sireesha et al. [27], Hapke et al. [7], Hapke and Słowinski [8], Hapke and Słowinski [9], Özdamar and Alanya [24], Yousefli et al. [35]). Accurate values of project characteristics (e.g. tasks duration) are in principle unknown for a scheduled unique project. Application of the fuzzy set theory allows handling the usually vague character of a necessary initial expert's information. The common problem is how to aggregate opinions of experts, which might be diverse and sometimes even opposing. Great effort to cope with this problem has been done in last two decades and an example of a suitable method for aggregating experts' opinions can be found e.g. in Vrana et al. [30]. Experts involved in the project scheduling should have a deep knowledge, personal experience and intuitive understanding of the problem. However, even if the best solution was calculated, the project manager should decide whether to adopt it or not.

Our research deals with fuzzy scheduling according to the classification of Dubois et al. [3] mentioned above. We aimed to find methods that can support project managers with necessary information to be able to make qualified decisions, in conditions of particular project objectives. Research papers with similar objectives usually focussed at the project duration and the critical path (e.g. Chanas and Zieliński [2], Liberatore and Connelly [17], Mares [20], Ziełinski [37], Sireesha et al. [26], Yakhchali and Ghodsypour [34]). Recent works refer also to the problem of project costs (e.g. Maravas and Pantouvakis [18]). Stikova [28] has also demonstrated that the fuzzy approach used for the estimation of project costs can support decisions for comparison of different project variants. Here, we focus at how fuzzy methods can help to optimize allocation of project resources. We shall outline the idea of detecting the risk of unwanted resource overlapping during the project execution as first published in Pelikán et al 2016 [42].

2 Project planning in conditions of ambiguity

We usually begin the project analysis by decomposing a project into specific activities. These activities may run independently, but sometimes cannot beginning of a certain activity should wait until the preceding activity was completed. The sequence of activities from the starting state to the terminal state is a path. The path duration is the total of durations of all activities on the path. The critical path is such the path which has the longest duration. This holds for durations expressed by classical variables and can be generalized analogically when using the fuzzy set theory, see e.g. Mares [19], Dubois and Prade [4], Novak [23], Wang and Kerre [33], Zadeh [36]. Each activity usually requires certain resources, for instance labour, equipment, rooms, etc. We will analyse allocation planning and utilisation of resources in conditions of ambiguity in activity duration by means of the fuzzy set theory. First, we shall focus on ambiguity in project planning, then in resource planning.

2.1 Project planning ambiguity

Assume that the project consists of N activities, A_i, $i = 1, 2, \ldots, N$, which connect states 0, 1, …, K. Let t_i be the duration of A_i, and let $\tau_i^{(b)}$ and $\tau_i^{(e)}$ be the beginning and end times, respectively, of A_i. Then

$$\tau_i^{(e)} = \tau_i^{(b)} + t_i \ , \qquad i = 1, 2, \ldots, N. \qquad (1)$$

With exception of the first activity, the beginning of any activity depends on ending of all preceding activities. If A_i follows after A_{i-1}, then

$$\tau_i^{(b)} \geq \tau_{i-1}^{(e)}, \qquad i = 2, 3, \ldots, N. \qquad (2)$$

If A_i follows after p activities $A_{i_1}, A_{i_2}, \ldots, A_{i_p}$

$$\tau_i^{(b)} \geq \max\left(\tau_{i_1}^{(e)}, \tau_{i_2}^{(e)}, \ldots, \tau_{i_p}^{(e)}\right). \qquad (3)$$

(2) and (3) hold only for not overlapping activities. In the case when activities may overlap, we must substitute τi-1 (e) in (2) by (τi-1(e) – Δti) and analogically also in relation (3). Then we can use relations (2) and (3) also for overlapping activities.

In real projects, there is always some uncertainty in a time management as it is impossible to foresee every eventual or random effect that will influence

progress of the project. This means to some extent that the beginning of an activity is also uncertain. In a project planning, we can express the ambiguity of both: activity beginning time and its duration by substituting deterministic time by the corresponding fuzzy quantities.

The moment when the activity finished is also a fuzzy quantity, thus we replace the classical addition in (1) by addition of fuzzy quantities

$$\tau_i^{(e)} = \tau_i^{(b)} \oplus t_i \qquad i = 1, 2, \ldots, N. \qquad (4)$$

Let $\mu_{\tau_i^{(b)}}$ be the membership function of the time $\tau_i^{(b)}$ when A_i begun and let μ_{t_i} be the membership function of duration t_i of this activity. Then, $\mu_{\tau_i^{(e)}}$, the membership function of the end time $\tau_i^{(e)}$ of A_i is given by

$$\mu_{\tau_i^{(e)}}(y) = \sup [\min (\mu_{\tau_i^{(b)}}(x_1), \mu_{t_i}(x_2)) : x_1, x_2 \in \mathcal{R}, x_1 + x_2 = y] \quad \text{for all } y \text{ from } \mathcal{R}. \qquad (5)$$

The time and activity duration are generally real numbers. We can, however, also consider them as integers (as multiples of appropriately chosen small unit of time) in order to simplify relation (5) as

$$\mu_{\tau_i^{(e)}}(z) = \sup [\min (\mu_{\tau_i^{(b)}}(x_1), \mu_{t_i}(x_2)) : x_1, x_2 \in \mathcal{R}, x_1 + x_2 = z] \quad \text{for all } z \text{ from } \mathcal{R}. \qquad (6)$$

Relation (6) expresses the possibility that A_i will finish in time z.

It is also important to determine the grade of membership when a certain activity is in progress at a certain moment. The membership function, $\mu_{A_i^{(b)}}$, of the situation that A_i started at or before moment z, is given by

$$\mu_{A_i^{(b)}}(z) = \sup [\mu_{\tau_i^{(b)}}(x) : x \in \mathcal{R}, x \leq z] \quad \text{for all } z \text{ from } \mathcal{R}. \qquad (7)$$

The membership function, $\mu_{A_i^{(e)}}$, of the situation that A_i will finish later than at moment z, is given by

$$\mu_{A_i^{(e)}}(z) = \sup [\mu_{\tau_i^{(e)}}(x) : x \in \mathcal{R}, x > z] \quad \text{for all } z \text{ from } \mathcal{R}. \qquad (8)$$

The membership function, $\mu_{A_i'}$ for the situation that A_i is in progress at moment z, is given by

$$\mu_{A_i}(z) = \min (\mu_{A_i^{(b)}}(z), \mu_{A_i^{(e)}}(z)) \text{ for all } z \text{ from } \mathcal{R}. \quad (9)$$

2.2 Resource planning ambiguity

Let us have M resources, either labour or equipment. We shall denote them Sj, j = 1, 2, …, M. If the activity Ai required resource Sj, then the membership function, μ(Ai)Sj, for the situation when Sj is allocated to Ai, i ∈ {1, 2, …, N} at the moment z, is given by

$$\mu^{(A_i)}_{S_j}(z) = \mu_{A_i}(z) \quad (10)$$

for all z from $\mathcal{R}$.

If within A_i several resources must work together simultaneously, relation (10) holds for the membership functions of all of the participating resources.

A serious constraint is that the above description of resource allocation does not consider a partial workload for resources. Because project planning and management often deals with resources that have insufficient and constrained capacities, the problem of overloaded resources deserves a deeper analysis. We will discuss possibilities of how to monitor and solve overloading of resources in a separate paper.

The workload of particular resources can be analysed using the membership function, $\mu^{(A_i)}_{S_j}$, given by relation (10). In addition to a classical deterministic resource planning, the fuzzy approach provides information on the status of a resource at any given time, as well as information on the possible resource workload for every moment of the project life. Such analysis of the possible overload of some resources enables us to foresee potential risks in resource allocation and to consider measures to minimize it.

3 Illustrative example

We shall show at a simple illustrative example how we can apply the previously described fuzzy set theory to the project planning. For simplicity, let our illustrative project consists of only seven activities and the project needs only three resources. We will consider no partial workloads. We will use this simple model to track progress of the project and to demonstrate consequences and benefits of the suggested technique. The schematic workflow of the example project is in Figure 1, where the nodes are project states and the arrows are project activities.

Table 1 shows the example project activities, A_i, $i = 1, 2,\ldots,7$, the values of their membership functions, $\mu_i(t)$, and the resources, S_i, $i = 1, 2, 3$, allocated to the corresponding activity.

In real projects, the project manager must adjust values of the membership functions according to technological requirements or he/she estimates them according to his/her experience or expectations in similar, previously implemented projects.

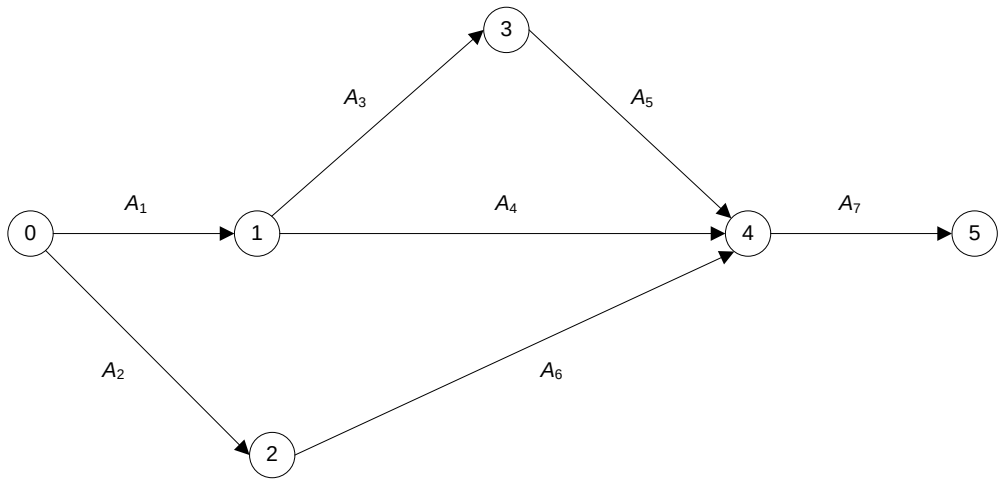

Figure 1 Project workflow, Source: Pelikán, 2016.

Table 1 Project activities, their membership functions and allocated resources, Source: Pelikán, 2016.

activity	membership function						allocated resource
A_1	$\mu_1(1)=0.1$	$\mu_1(2)=1.0$	$\mu_1(3)=0.6$	$\mu_1(4)=0.2$		$\mu_1(t)=0.0$ elsewhere	S_3
A_2		$\mu_2(3)=1.0$		$\mu_2(5)=0.5$		$\mu_2(t)=0.0$ elsewhere	S_1
A_3	$\mu_3(3)=0.2$	$\mu_3(4)=1.0$	$\mu_3(5)=0.6$	$\mu_3(6)=0.4$	$\mu_3(7)=0.1$	$\mu_3(t)=0.0$ elsewhere	S_3
A_4	$\mu_4(5)=0.1$	$\mu_4(6)=1.0$	$\mu_4(7)=0.1$			$\mu_4(t)=0.0$ elsewhere	S_2
A_5		$\mu_5(4)=1.0$	$\mu_5(5)=0.5$	$\mu_5(6)=0.2$		$\mu_5(t)=0.0$ elsewhere	S_1
A_6	$\mu_6(5)=0.3$	$\mu_6(6)=1.0$	$\mu_6(7)=0.9$	$\mu_6(8)=0.7$	$\mu_6(9)=0.2$	$\mu_6(t)=0.0$ elsewhere	S_3
A_7	$\mu_7(1)=0.2$	$\mu_7(2)=1.0$	$\mu_7(3)=0.8$	$\mu_7(4)=0.3$		$\mu_7(t)=0.0$ elsewhere	S_2

3.1 Calculating of beginning and ending membership functions

Using relations for union, intersection and sum of fuzzy quantities we find the membership function of the moments when each activity can begin and end. In our example A_1 and A_2 (see Figure 1) begin at time 0 and every subsequent activity begins just after the previous activity, or activities have finished. We can see for instance that A_3 begins immediately after A_1 has finished. The membership function of the end time $\tau_3^{(e)}$ of A_3, $\mu_{\tau_3^{(e)}}$, is calculated from the membership function of end time $\tau_1^{(e)}$ of A_1, $\mu_{\tau_1^{(e)}}$, and the membership function, μ_3, of the duration of A_3 (given in Table 1), using relations (2) and (6). The project finished after A_7 has finished, and the grade of membership of finishing A_7 and the grade of membership of terminating the project are equal.

The values of membership functions are visualised in Figure 2. Each graph is a specific membership function as a function of time. The first column shows the values of the membership function at the beginning of the activity whilst the second column displays the membership function for the moments when the particular activity has finished.

As we previously mentioned, the last graph on the right also represents the membership function of the moment when the entire project will terminate. We can see that the project termination has a wide time uncertainty (from 9 to 21 time units) which corresponds to real situations when the duration of each project activity is estimated with a time span. Note that the value of the membership function assigned to duration of each activity affects duration of the whole project. This information is very important for project planning and management because it enables us to consider in advance different project alternatives and possibilities and to take adequate measures.

3.2 Membership functions of activities

Let us find the membership function for an activity occurring at a certain moment. Using relations (7), (8) and (9) for the membership functions from Fig. 2 we calculate the values of membership functions μ_{A_i} $i = 1, 2,\ldots, 7$ for every activity and time.

Our illustrative project starts at time 0, thus activities A_1 and A_2 will be in progress in the time interval $< 0 ; 1 >$, and their membership functions have the value 1.0.

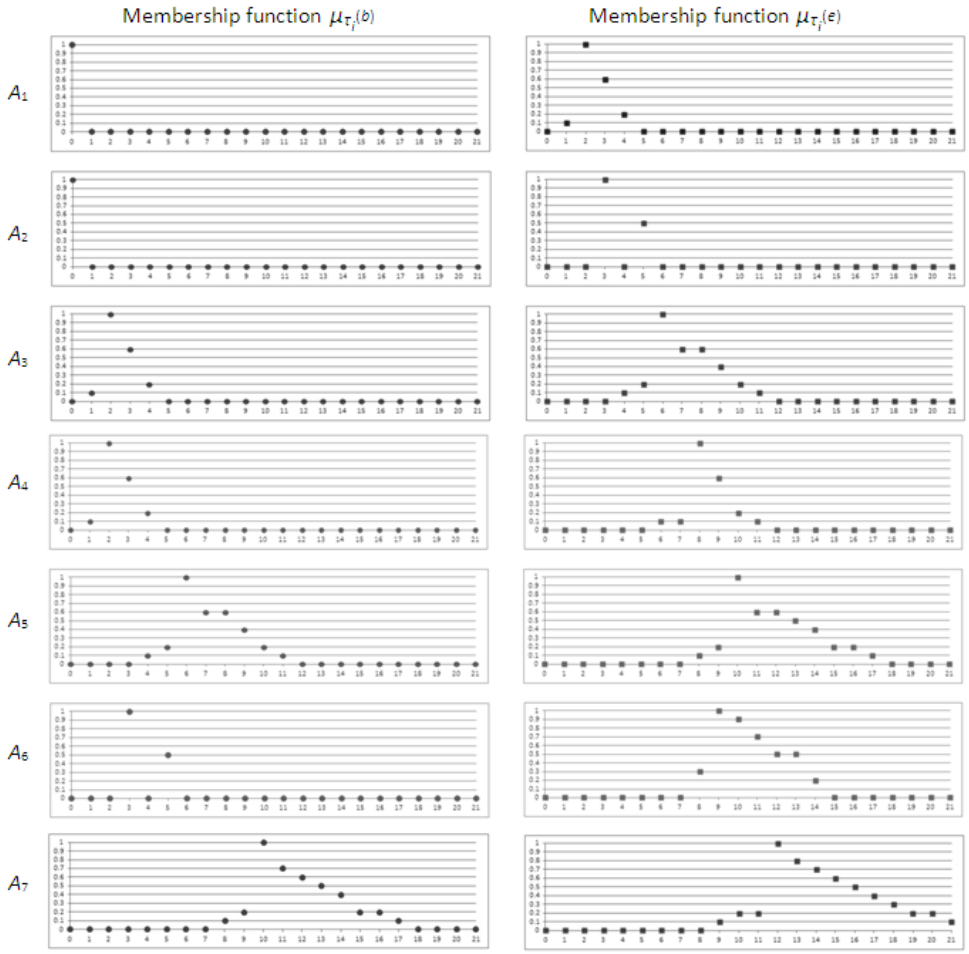

Figure 2 Membership function for the beginning and ending times of project activities, Source: Pelikán, 2016.

For example, we shall examine performance of activity A_3. The value of the membership function of A_3 beginning at time 0 is 0.0, and the membership function's value of its beginning at time 1 is 0.1 (see Fig 2). Therefore, membership function $\mu_{A_3(b)}$ of the situation when A_3 begins before or at the moment z, is

$$\mu_{A_3(b)}(z) = 0.1 \qquad \text{for } 1 \leq z < 2. \qquad \textbf{(11)}$$

A_3 will end in the time interval < 4 ; 11 > - see the values of $\mu_{\tau_3(e)}$ in Fig 2. The value of the membership function of ending A_3 later than at the moment z, $1 \leq z < 2$, is 1.0 , i.e.

$$\mu_{A_3^{(e)}}(z) = 1.0 \qquad \text{for } 1 \leq z < 2. \qquad (\mathbf{12})$$

Thus, according to (11), the value of the membership function of the A_3 executed in time z, $1 \leq z < 2$, is

$$\mu_{A_3}(z) = \min (0.1 ; 1.0) = 0.1 \qquad \text{for } 1 \leq z < 2. \qquad (\mathbf{13})$$

Analogically, we can also examine behaviour of all remaining activities. All calculated values of the membership functions are recorded in Table 2.

Table 2 Membership functions of project activity execution, Source: Pelikán, 2016.

member- ship function	time																						
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
μ_{A_1}	1.0	1.0	0.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
μ_{A_2}	1.0	1.0	1.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
μ_{A_3}	0.0	0.1	1.0	1.0	1.0	1.0	0.6	0.6	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
μ_{A_4}	0.0	0.1	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
μ_{A_5}	0.0	0.0	0.0	0.0	0.1	0.2	1.0	1.0	1.0	1.0	0.6	0.6	0.5	0.4	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	
μ_{A_6}	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.7	0.5	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
μ_{A_7}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.0	1.0	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.1	0.0	

The membership function in Table 2 has for every activity the value 1.0 in the time interval for the duration time with the largest membership function. For instance, the activity A_3 is expected to last 4 time units and it will be executed with the largest value of its membership function from time 2 to time 6. The Table 2 also shows that the project duration will be, at most, 21 time units.

3.3 Graphical representation of resource allocation

In our illustrative project, we considered three resources S_1, S_2, S_3 to individual activities, see Table 1. In Figures 3, 4 and 5 we graphically represent the values from Table 2 as the membership functions of the resource workload.

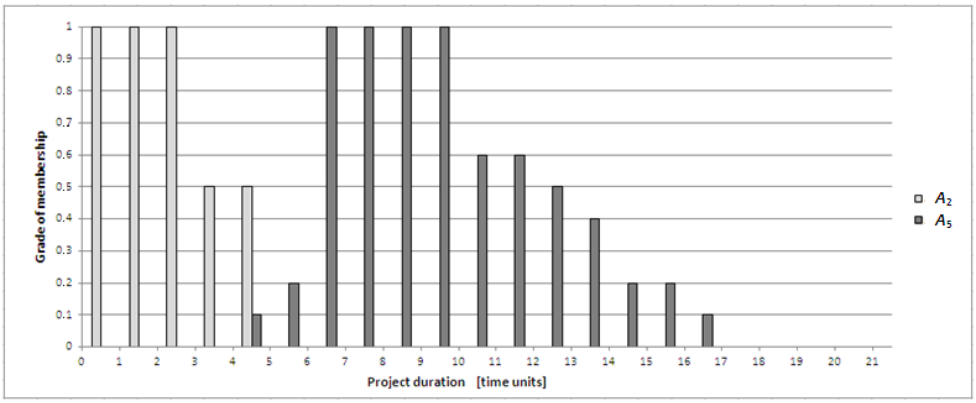

Figure 3 Membership function of the project workload of the resource S_1, Source: Pelikán, 2016.

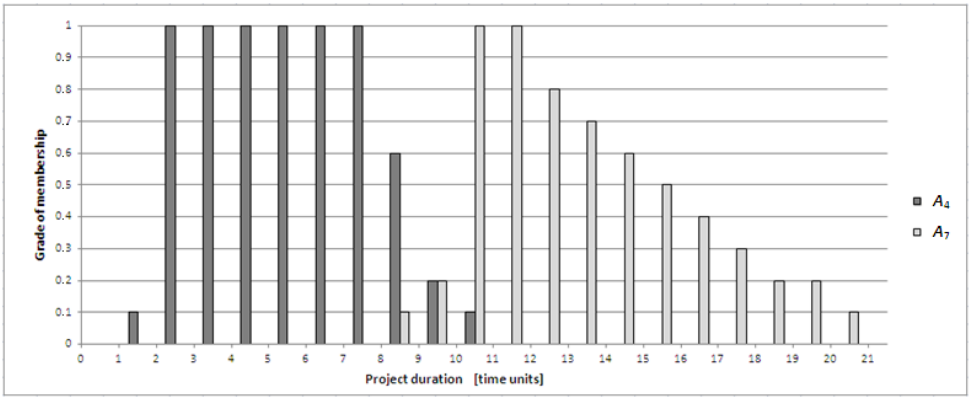

Figure 4 Membership function of the project workload of the resource S_2, Source: Pelikán, 2016.

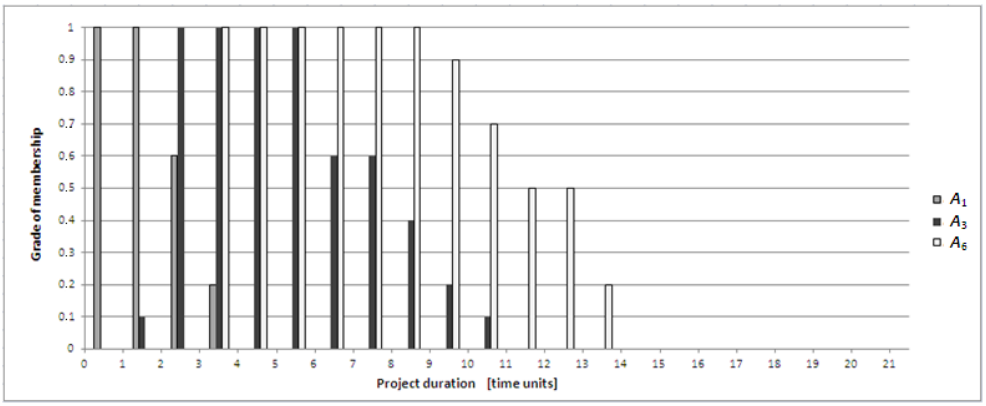

Figure 5 Membership function of the project workload of the resource S_3, Source: Pelikán, 2016.

These graphs show the possible workload of particular resources during the project life due to the corresponding activities. Resource S_1 in Figure 3 is allocated to two activities A_2 and A_5, whilst the resource S_1 can be simultaneously used by both activities in the 5th time unit, i.e. their overlap may occur. Nevertheless, the values of the membership function of their execution are quite low in the time interval where the overlap may occur. Therefore, there is a little risk that S_1 will be overloaded, and this overlap can be accepted. It similarly holds for S_2 in the 9th and 10th time units, where the low risk of troubles will likely be also ignored. But the resource S_2 can become slightly overloaded in the 11th time unit.

Nevertheless, there is a different situation with S_3. In time units 3rd - 9th there is a significant overlap of three activities, with large values of their membership function, which indicate a substantial risk of overloading S_3. The project manager must either add a new resource for the A_3 or shift beginning of corresponding activities to avoid such overlap, which could cause an extensive overloading of S_3. The values of the membership function provide guidelines for the correct decision of how to shift beginning of relevant activities. This clearly demonstrates the feasibility and possible troubles of the designed resource allocation.

Figures 3, 4 and 5 also show advantages of the fuzzy approach in comparison to the deterministic approach. The classical deterministic activity durations correspond to the fuzzy description where the activity durations have a membership function equal to 1.0. This correlation causes that the project manager would not recognise the possible overlap of activities for S_1 and S_2 in

the deterministic approach. These resources might seem to be available for another activity in wide time intervals (S_1 in the time intervals < 3 ; 6 > and < 10 ; 21 >; S_2 in the time intervals < 0 ; 2 >, < 8 ; 10 > and < 12 ; 21 >). Still worse situation will happen for the resource S_3. In the deterministic approach, the overlap of two activities would be visible only in the time interval < 3 ; 6 >, and the **possible overlap of three activities would not be recognised at all!!!**

4 Conclusions

The fuzzy set theory methods can be suitable instrument for modelling the uncertainty in the project description. They can give a more realistic insight into alternatives in project arrangement with respect to deterministic methods; since results in a fuzzy method quantify the possibility of occurrence of each alternative. Our research has extended the range of utilisation and discussed how to use fuzzy methods to optimize project resource allocation beyond the project duration and the critical path. We evaluated the derived relations for the membership functions of the activity beginning and end times, the activity execution and the resource workload in a real project of information system implementation. Utilisation of the fuzzy method positively contributed to the successful completion of the project, see [42]. The presented results document the benefits of the suggested technique for resource and project management. These methods can detect potential problems of designed resource allocation, including the evaluation of their threat, and help in considering variety of project alternatives. It generally holds that performance of the fuzzy approach is never poorer than in the classical, deterministic approach, but it can be superior in many practical situations.

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Psychological Aspects of Project Manager Activities in IT Projects

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Abstract. This paper is focused on the psychological aspects of project manager activities in IT projects, which considerably influence the results of the project. Management which appoints the project manager cannot choose only according to his technically competent and knowledge of the methodology, but also in regard psychological aspects of this job. Project manager must have a talent for this activity which cannot be fully learned. In the text are specified 10 psychological aspects that may be called "art" and the success of the project is depend on mastering those aspects. It is about art: decide, listen, acknowledge a mistake, communicate, empathize with the needs, work with information in terms of relationships inside and outside the team, coach, take responsibility, identify and assess the risks.

Keywords: project manager, psychological aspects as art, coach, communication, empathy,

JEL Classification: M15

1 Introduction

Every IT project is facing the problems that arise objectively (eg. environmental changes, project scope, resource...) or subjective faults of the project team. Project Manager (PM) is responsible for the progress of the project - for the implementation of content at a specified time and defined resources. PM works under psychological pressure, especially when you realize he often leads several projects at the same time - usually two to six projects simultaneously.

The basis of project management is project methodology to determine the procedure for managing the project or make recommendations how to proceed. Methodologies does not deal with the behavior of PM. The following text will be discussing view of the psychological aspects of project management - what demands require the position of PM and what selection by PM.

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Based on my rich experience I can say that for the success of the project it is not enough only technical methodological skills, important is also dealing with the emotional and psychological requirements for work with people. There are many guides on how to manage people, something can be learned, but who does not have sufficient psychological requirements how to manage emotions and people generally fails (as a musician without musical hearing cannot succeed).

Even in the psychological aspects are recommended procedures (Belbin), those are generally recommended characteristics that generally PM or leader / manager should have (to be decisive, leading people ...). The following text specifies what must PM cope with and have a talent for it, therefore individual points are marked as "art".

For project management, there are generally recognized corporate project methodologies (PMBOX, PRINCE2, Chester, ASAP, ...) regularly used as a set of processes to ensure a smooth workflow from beginning to the end. These methodologies are dedicated to best practices in the various stages of project implementation, organizational issues, determining the roles, documentation. (Doležal, Máchal and Lacko, 2012).

2 Methodological background - personal skills

Project Manager role is defined in methodologies. According to the methodology PRINCE2 (OGC, 2009) "A person who is given the authority and responsibility for the daily management of the project in order to deliver the desired product under restrictive conditions agreed by the steering committee of the project".

Definition of the Project Management Institute's PMBOK methodology: "The project manager is the person designated by the organization to achieve the project objectives". (PMI, 2000)

S. Pearson (Pearson in Armstrong, 2002, p. 432-435) compared the project management to the orchestra where the conductor is the project manager and individual instruments controlled by individual members of the orchestra (the team members). The score is entered work.

Manager is a conductor and staff are the musicians. All are bound by the score. “Any sign of a conductor with a special order, which can not be anything

personally mood. Every good musician knows already in advance what command will follow, and is able to assess whether it was issued properly. If the conductor is unable or moody, he creates chaos and performance is inconsistent. Everyone must obey the code, which should ensure a smooth and cost-effective implementation of a common task. And yet even the law leaves ample opportunities for musicians able to apply their skills and virtuosity. "

This comparison is apposite, but the PM work on IT projects is more complicated in comparison to the conductor and his orchestra. Musicians have prescribed musical signs, know the character of the composition. The conductor then unifies the look and feel of the composition.

Methodology commonly used for project management focuses on the technical process solutions, neglecting the area of Soft skills and psychological suppositions where the individuality influences the course of the project. The project team is composed of people and therefore must be understood as a team member's personality, which is associated with the experience, knowledge, motivation and personal conditions. And these assumptions are often very important or even decisive for the team and the success of the project

For IT projects are given objectives, scope and resources, but the way to achieve depends on different aspects (eg. unclear scope of IT project, changes in sources). The IT team should take into consideration views and opinions of the team members, their moods and personal issues, as well as customer feedback, implementation problems, etc. which conductor may not solve (or not to the same extent). Managing role in the team is a basic necessity / obligation of PM in the IT project.

One possibility identifying personality skills explored various psychological tests that can serve as a tool for self-knowledge, or to select a project role for implementers of the project. The most commonly are used Belbin test that tests assumptions for certain roles in the team when by the truthful completion of the test, the results show the particular team roles. Project manager of this test should exhibit characteristics such as decisiveness, strong sense of responsibility, perception of reality, the ability to deal with members of the team on merit and without bias, natural respect. As an allowable weakness include mediocrity in terms of creativity and intellect.

Similarly Bender (2008) cites skills demanded for leaders: they are fostering self-esteem of the others, they show direction, they contribute to the

results, the show how to reach certain objective, they succeed in progress that is beneficial not only to them, but also to the others.

In the literature (Nový,Jarošová and Bedrnová, 2012), (Athavale, 2013) is possible to obtain list of personal expectations, for instance (Adair, 2009) states 25 psychological attributes ordered from the most valuable as assessed by the successful leaders and managers: decisiveness, ability to lead the people, integrity, enthusiasm for work, imagination, willingness to work hard, analytical thinking, understanding with the others, ability to identify the opportunity, ability to solve difficult situation, flexibility, willingness to take risk, initiative, ability of speaking clearly, perspicacity, ability to effectively solve the right questions, objectivism, stamina, willingness to work overtime, get-there skill, single target focus, ability of clear written discourse, curiousness, aptitude to work with numbers, competence of abstract thinking. Management requires PM to possess all 25 attributes, but it is unrealistic.

(Plaminek, 2015) states people's motivation in the particular moment is mixture of the three influences: long-term inner foundation, external factors and momentary inner attunement.

Long term inner foundation of the team member the PM doesn't change, but can be attested. External factors within the work environment can PM influence from the perspective of health, work focus etc. The PM can influence the momentary inner attunement the most.

Chapter 3 is concerned about the PM skills to help him to approximate to desired status and fulfil the points 1-25.

3 Psychological aspects and assumption of successful IT PM work

In this chapter are summarized (and proved by empiric experience) basic assumptions of the "art" for successful work of the PM in the IT area as well as people leadership. PM must handle, while driving the project, many of the aspect:

a) organizational – management of people, time and resources,
b) professional – factual matters of the project, systematic project management,
c) coaching – people management and related psychological skills.

Area of the project management is further analyzed as important premise of the project fruitfulness and it is advisable to set the demands on position of the project manager, which should be clear to company management, and emphasize those when assigning the project.

It is important to realize many of the skills are desirable for any leading position within the company organizational structure, although the project manager role is very specific. Once defining the role of the project manager it is necessary to become aware that project manager must handle one-time tasks, doesn't have stable team – project to project the team often changes, but personal changes may occur even during the project execution phase, different roles or occupations thereby persons in dependence on the project's needs and time schedule. Every day different external situation may occur and project manager must solve it by substandard approach.

In contrary to project manager position the leading position in the organizational structure (for instance lead of accounting dpt., IT manager…) defined by company's organizational rules and routines. Simultaneously in the organizational structure by given department, the tasks are executed with the same stable team. However in those types of teams impend different problems (for instance cabin fever). Project management can be compared rather to "expedition to Himalayas"

It is management accountability to realize, once promoting project manager, it is not only expertise, but also people management, and if this fact is neglected, even the expertise would be depreciated. "Sheldon can't be the team leader (Big Bang Theory), super genius lacks certain social skills and is ineligible for leadership role.

Fundamental role ITPM is to drive and decide. Experience proves project manager must master at least the following "arts" (often the literature refers to "leading is an Art") It is inevitable to realize those aren't only skills that can be mastered, but also there is definite level of talent.

3.1 The art of decision making and being rigorous

PM must make decisions. In order to make right decisions, he has to have the courage to decide (for instance when lack of information and with it goes also ability to differentiate when he needs to decide and when he can delegate the decision). He must be decisive in key situations. Obviously the PM can't make

decisions independently. Except for key points he has to solve unclear and litigant problems. Other problems can be solved by the subordinate team members. At the same time he has to be rigorous and demand the decisions to be fulfilled. Unacceptable is when the PM decides everything absolutely or, on the other hand, when delegates all the decision making. Exceedingly coming under other's opinion may lead to the team decomposition. The flaw is not to decide because of lack of decisiveness or frequent opinion change.

3.2 The art of listening to the others

PM must be able to listen (indeed this applies outside the project too), this is demonstrated by open-minded communication, ability to understand the message in the context of the work frame as well as the personal relationships. It must be emphasized it is not only about opinions to conduct the project, but also the disagreements within the team or difficulties with customer. It is desired the team is informed about dilemmas. Important is paradigm of communication with the team members and ability to find space for individual discussions with the team members.

3.3 The art of admission of own mistakes (mea culpa)

Confession of own mistakes is very difficult discipline, but it is basic attribute of the psychological part of the project management, it gives opportunity to awake respect towards PM. On the other hand too many mistakes may discredit PM in the leading role. The other case is to confess the flaw towards the customer or company management; this may have implications on the project. However, even in this case it is better to start solving the mistake as soon as possible to minimize financial as well as time losses.

3.4 The art of accepting the responsibility

In case the team lapses, the PM must accept the responsibility for the team work and cascade responsibility inside the team. The PM cannot take alibistic approach and blame only subordinates. This would be the best way to discredit yourself in company leadership team as well as team member's eyes.

3.5 The art of communication

The art of communication spreads along several levels. Those blend together – operational and relationship levels. Even the communication about the work issues encompasses the relationship's level between the PM team members. Simultaneously can be differentiated between communication among the team members and the external towards the customers, etc. The communication can be executed in different means not only verbal, but also written. The art of communication applies to the written form too.

1) Inner communication within the team- this category covers leading the meetings and communication towards the team members. Specific problems may arise when leading international teams, where, amongst others, the distance and time difference as well as the communication language are important. PM greatly influences the mood in the team.

a) Meeting leadership – of course there are numerous methodologies and studies how to lead the meeting, but mistakes in this area are frequent. (for instance the PM talks 95% of the time not providing time for the other participants of the meeting.)
b) Communication towards individual team members, that shall cover:
   - task assignment – comprises of estimation of the way of the task assignment, each member is suitable for the different process: order, discussion over the task, definition of the awaited outputs...
   - task supervision – the supervision can be direct and indirect, but it is necessary to judge if the team member the results only submits or if it is advisable to discuss the results. It is needed to assess individual requirements for the communication over the results.
   - People assessment – reflection of work made – criticism, appreciation, award, should be correct, honest, non-biased – it is basic assumption, nevertheless very important. The correct assessment needn't to be fair to the person (taking into the account personal issues, age). Dangerous is also the bias.
   - Motivation and pursue the goal
c) Solving of the problematic personal relationships among the team members.

2) Communication outside the team – this kind of the communication is difficult to generalize without specific situation description. Communication can be conducted in the different means based on the main persons involved.

Those could be company management, cooperating departments, customers, external consultants, vendors.

3.6 The art of empathy

Empathize with the needs of the team members as well as the customers and solve the problems. In such case it is highlighted if the PM dispose appropriate character traits – calmness, patience, respect to the others, observation of other opinions. Even in this case the PM must posses the talent that can't be drilled.

3.7 The art of handling the information in accordance to relationship

Information, its sharing and spreading in time are the basic premise for the functioning team. Wide-spread abuse is concealing the information in order to promote himself or make the notion of self-indispensability. This is often mistake made by PM. As the researches prove…. "It is hard to cooperate with the man who is trying to self-promote himself. The other extreme are the gossips within the team.

3.8 The Art of coaching

The art of coaching is different skill to leading the meeting. This art is expressed during complex discussion over problem and wide variety of approaches to solve the problem. PM must be able to attenuate negative emotions, keep the team on the tract towards the problem solution. Must be able to capture supportive ideas, enable their identification and fostering. It is not advisable emphasize own personality and promote yourself.

3.9 The art of right potency estimation

As mentioned at the beginning of the article, PM solves in parallel several projects and he must be able to assess the powers to manage the projects. The accomplishments of the PM shouldn't be assessed based on the number of projects, but weight / estimate whether PM has experience, skills, knowledge and the self-confidence to execute the objective. Over-estimation of self's skills leads to physical as well as psychical collapse of the PM. Into the category of the self-assessment also belongs the fear emotions, which, in high levels, can paralyze the whole project.

3.10 The art of identifying and assessing the risk

There are many types of the risks: factual – described in methodologies, relationship oriented risks – caused by different temper or people's motivation. External risks – customers, vendors, consumers, subcontractors) – even those risks must be perceived, hypothesized, registered, tracked, assessed, evaluated and mitigated.

4 Conclusion

The paper shows 10 important psychological aspects of PM, which can be called as art and it is necessary to have for successful work of PM:

There are arts of decision making, listening to the others, admission of own mistakes, accepting the responsibility, communication, empathy, handling the information in accordance to relationships, work with information in terms of relationships inside and outside the team, coach, take responsibility, identifying and assessing the risk. Counterproductive properties are complacency, indecisiveness, sense of superiority, underestimation of risks, etc.

Management which appointed the PM can´t choose just by the way is a skilled, he knows the methodology as experienced, punctual, well ... that manages mentioned "art" and assess its impact on past projects and in teams. PM must have a talent for this activity which can´t be fully learned.

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Meta-analytic SEM in Development of TAM Models

Adam Sagan[1], Mariusz Grabowski[2]

Abstract. The paper objective is to integrate the meta-analytic approach and Structural Equation Modelling (SEM) in an estimation of Technology Acceptance Models (TAM). This integration stems from the fact that a model building process uses extensively the prior knowledge and existing research findings based on meta-analysis of journals resources. Especially the latter method is integrated with SEM enabling the meta-analytic approach to SEM (MASEM). The prior knowledge is therefore crucial for the estimation of Bayesian MASEM models that are based on prior distribution of the parameters space. In the development of MASEM - based TAM models of attitudes toward the Moodle platform, the meta-analysis of TAM models is combined with primary data gathered from a questionnaire research among the students of Cracow University of Economics concerning the attitudes and usage of Moodle platform.

Keywords: Meta-analysis, TAM, SEM, Bayesian inference.

JEL Classification: L86, C51, C69

1 Introduction

There seems to be no effective and generally accepted quality assessment method of e-learning as much as there is no single definition of e-learning or an e-learning quality standard. In this paper, the term e-learning is understood as the socio-technical system. This holistic perspective includes two basic components: (1) social – concerned with the attributes of people and (2) technical – consisting in processes, tasks, and technology needed to transform inputs to outputs. The output of this system is a product of the constant interaction that is taking place between these two components. The quality of e-learning may be assessed only in the relationship to the people who interact with it (learners and instructors) and the organization that creates the surroundings for learning process. The literature analysis conducted by Grabowski (2015) allows to distinguish three categories of methods for e-

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learning quality assessment: theory-based, institutional-based and standard-based. The theory-based category, which is predominant within scholarly literature, includes social cognitive theory (SCT) or technology acceptance model (TAM) as the main theoretical concepts.

The main objective of the study is to integrate existing research findings concerning theory-based TAM models within the general framework of meta-analytic structural equation modelling (MASEM). This integration enables an interpretation of modelling results in a broader context of data and a comparison of the findings based on primary data with the results obtained with "big data" SEM models.

2 Meta-analysis of TAM Models

Technology Acceptance Model (TAM) (Davis, 1989; Davis, Bagozzi and Warshaw 1989) and its derivatives, e.g. UTAUT (Unified Theory of Acceptance and Use of Technology) belong to the most frequently used theoretical frameworks to interpret behavior of users with regard to IT/IS artifacts and their acceptance. Its theoretical foundations are acquired from the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) (Ajzen, 1985). TAM model has been validated and applied in numerous studies existed in the ICT literature. Many of research is based on structural equation models (SEM) approach (Sagan and Grabowski 2015). The multitude of published results has been contributed to a number of studies in the meta-analysis of TAM models that allow an assessment of the stability of the measured results in the relationships between variables

In order to do meta-analysis of studies, the articles published in the three leading scientific journals of Information Systems (IS) community, namely: MIS Quarterly (MISQ - IF 2015 = 5.384), Information Systems Research (ISR - IF 2015 = 3.047) and Information Systems Journal (ISJ - 2015 IF = 2.522) were selected. The TAM-related query resulted in the collection of 29 papers published over the 24 years (from 1991-2014). American (MISQ and ISR) periodicals prevail in the structure of the publications, given that 23 articles constitute almost 80% of the total collection. This result does not get explained merely by the fact that the query was run on two American magazines and only one European but rather by the tendency associated with leaning for acceptance of positivist (which include TAM) approaches in the American scientific

tradition. As a result of further article analysis, 55 studies were selected for the meta-analytic SEM (some articles were based on more than one TAM-related research).

3 Meta-analytic SEM

Meta-analytic structural equation modeling (MASEM) is an important extension of the classical individual SEM. It tries to solve an important scientific problem - how to integrate, combine and compare research findings. The meta-analysis (MA) is the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings (Glas 1976; 3). The research objective is to test the consistency of the effect sizes across studies and to estimate the pooled effect size. It allows to generalize the findings across studies, identify potential moderators in the model structure and obtain the appropriate estimates given a larger sample sizes. SEM is a powerful statistical method for estimation multivariate regression models with latent variables that combines regression analysis with (confirmatory) factor analysis.

The combining of SEM and MA gives sufficient improvements in the estimation of structural equation models: 1/ structural equation modelling requires large sample sizes while combining the information from many samples and studies may increase the statistical power, 2/ in many individual studies only partial solution to given research questions may exist. Integration of studies enables obtaining the more complete set of hypotheses and estimated parameters (Jak 2015, Cheung 2015). MASEM usually exploits a two-stage approach. In stage 1, the homogeneity of correlation matrices is tested and pooled correlation matrix is estimated. In stage 2, SEM models based on pooled correlation matrix are estimated. Estimation of pooled correlation coefficients in univariate approach is given as a weighed correlations or weighed Fisher - z scores. The univariate approach is not broadly recommended because not all studies may include all variables (danger of non-positive definite matrices) and correlations based on less studies may be estimated with less precision. In multivariate approach, the generalized least squares (GLS) or two-stage structural equation modelling (TSSEM) that is based on all correlation coefficients and their dependence is used. In MASEM the two-stage approach gains more popularity because it uses the multi-group structural equation modelling to pool correlation coefficients. There are three

approaches to MASEM: 1/ fixed - effect SEM, 2/ random-effect SEM and 3/ mixed-effect SEM. In fixed-efect SEM, the effect sizes (correlations, covariances, path coefficients etc.) are assumed to be comprehensive summaries of many effect sizes and their estimated sampling variance (differences between studies are the result of sampling error only). If effect sizes are homogeneous across studies, the weighted average of effects are unbiased estimate of the population effect size that share the common value. The random-effect SEM assumes that studies are not simple replication of each other and the effect size may vary due to differences in samples and methods used in different studies. The random-effect SEM can be used where the researchers wish to make inferences and generalizations on beyond the studies used in the analysis. Random-effect SEM models include not only sampling variance, but also the between - studies variance components. The mixed-effect model is used with models with covariates and include both fixed and random effects. The fixed effects are due to the study-specific covariates, and the random effects are the unexplained study-specific effects after controlling for the covariates (Cheung 2008, p. 185).

4 Meta-analytic SEM of TAM

Meta-analytic SEM of TAM models was estimated using the data consisted of the correlations between constructs in original TAM model. The correlations were gathered from 55 studies identified in 29 publications in contemporary scholarly journals from the IS field. This data was already presented by Wu and Lederer (2009). The excerpt of the raw database is given in table 1.

Table 1 Raw data file for meta-analytic SEM; Source: (Wu and Lederer, 2009)

	Name	Year	Source	Sample size	UE	UB	EB
1	Agarwal	2000	(J)	288	0.55	0.65	0.57
2	Agarwal	1999	(J)	230	0.74	0.45	0.36
3	Aladwani	2002	(J)	387	0.37	0.44	0.39
4	An	2005	(D)	200	0.71	0.68	0.48
5	Busch	1995	(D)	249	0.21	0.57	0.23
6	Davis	1989	(J)	80	0.56	0.85	0.59
7	Featherman	2002	(D)	215	0.59	0.71	0.54
8	Featherman	2003	(C)	167	0.63	0.72	0.58
9	Gefen	2003	(J)	161	0.64	0.48	0.38
10	Gefen	2003a	(J)	139	0.75	0.18	0.1
11	Gefen	2003a	(J)	178	0.72	0.38	0.35

The estimations were calculated using “metaSEM” library of R package, OpenMx program and Mplus for structural equation modelling. For meta-analytic SEM only limited version of TAM model was tested that involves the

relationships between perceived ease of use (E), perceived usefulness (U) and behavioral intention of use (B). In the first step of the analysis, the data sets in forms of correlation matrices along with sampling sizes were calculated:

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     N   UE   UB   EB
1 288 0.55 0.65 0.57
2 230 0.74 0.45 0.36
3 387 0.37 0.44 0.39
4 200 0.71 0.68 0.48
5 249 0.21 0.57 0.23
6  80 0.56 0.85 0.59
```

Figure 1 Correlation coefficients and sample sizes; Source: own based on metaSEM.

N - sample size
UE - correlation between "ease of use" and "perceived usefulness"
EB - correlation between "ease of use" and "behavioral intention of use"
UB - correlation between "perceived usefulness" and "behavioral intention of use"

Figure 1 depicts the correlation coefficients between selected constructs of TAM model for the first 6 studies in the database. The original data was converted into a set of correlation matrices. Figure 2 presents matrices for studies given in figure 1.

```
> cormatrices
[[1]]
     U    E    B
U 1.00 0.55 0.65
E 0.55 1.00 0.57
B 0.65 0.57 1.00

[[2]]
     U    E    B
U 1.00 0.74 0.45
E 0.74 1.00 0.36
B 0.45 0.36 1.00

[[3]]
     U    E    B
U 1.00 0.37 0.44
E 0.37 1.00 0.39
B 0.44 0.39 1.00
```

Figure 2 Correlation matrices between constructs; Source: own based on metaSEM

Given the correlations, two - stage SEM was applied for obtaining pooled correlation matrix for subsequent TAM model. Both a fixed-effect and a random-effect models were estimated. In the fixed - effect model the pooled correlation coefficients treated as unbiased estimates of population correlation matrix were calculated:

```
Coefficients:
       Estimate Std.Error z value  Pr(>|z|)
S[1,2] 0.5467940 0.0069134  79.092 < 2.2e-16 ***
S[1,3] 0.4542316 0.0077968  58.259 < 2.2e-16 ***
S[2,3] 0.6010102 0.0062973  95.439 < 2.2e-16 ***
```

Figure 3 Estimated pooled correlation coefficients; Source: own based on metaSEM

Figure 3 gives the estimates of path coefficients, their standard errors, Z values and p-levels. Total sample size was 10766 respondents. The goodness of fit indices for the model with equality constraints on all correlation coefficients shows the poor fit that indicates a lack of homogeneity (□2

statistic = 1414.80, df = 153, p-level = 0.000, RMSEA = 0.19, TLI = 0.87). In random-effect model, the intercepts (effect sizes) and random effects (tau) were calculated.

```
Coefficients:
           Estimate Std.Error    lbound    ubound z value  Pr(>|z|)
Intercept1 0.5482583 0.0210541 0.5069930 0.5895236 26.0404 < 2.2e-16 ***
Intercept2 0.4677038 0.0206228 0.4272838 0.5081238 22.6790 < 2.2e-16 ***
Intercept3 0.6003339 0.0191124 0.5628743 0.6377936 31.4107 < 2.2e-16 ***
Tau2_1_1   0.0196798 0.0044335 0.0109903 0.0283693  4.4389 9.043e-06 ***
Tau2_2_2   0.0181367 0.0041191 0.0100633 0.0262100  4.4030 1.068e-05 ***
Tau2_3_3   0.0162390 0.0036416 0.0091015 0.0233764  4.4593 8.224e-06 ***
```

Figure 4 Random - effect parameters; Source: own based on metaSEM

Figure 4 presents the average (pooled) correlations (*Intercept*) and between - study variances of correlation coefficients as random effects (*Tau*). Additionally, the random effect model provides the Q tests of effect sizes homogeneity across studies.

```
Q statistic on the homogeneity of effect sizes: 1561.897
Degrees of freedom of the Q statistic: 153
P value of the Q statistic: 0

Heterogeneity indices (based on the estimated Tau2):
                                 Estimate
Intercept1: I2 (Q statistic)       0.9100
Intercept2: I2 (Q statistic)       0.8731
Intercept3: I2 (Q statistic)       0.9113
```

Figure 5 Q tests of effect size homogeneity: Source: own based on metaSEM

The Q statistic (p-level = 0.00) shows that the hypothesis concerning homogeneity of correlations across studies should be rejected. The heterogeneity indices based on Q statistic also provide the information about strong heterogeneity of correlation coefficients.

Because of correlation coefficients heterogeneity, the random - effect model was selected for the stage 2 solution. In the stage 2, the TAM structural equation model based on pooled correlation matrix was estimated using OpenMx library of R package and weighted least squares (WLS) estimation. The hypothesized model in 2 stage is fitted using the tssem2 function in R package.

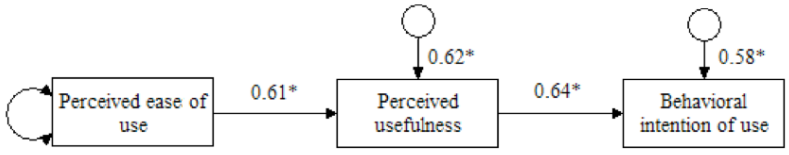

Figure 6 TAM path model estimates; Source: own based on OpenMx

The goodness of model fit is acceptable. The aggregate sample size is 10766. Chi-square of target model is 67.01 with 1 df and p-value = 0.000. The RMSEA is marginally acceptable 0.078 (CI: 0.063 - 0.095) and comparative fit indices TLI and CFI are respectively 0.083 and 0.94. The parameters of the MASEM model depicted in figure 6 was used as an a priori information for Bayesian SEM model on primary data. The use of a priori information is a distinctive advantage of Bayesian models (Rossi, Allenby and McCulloch, 2005) The data were based on quota sample of 150 students of Cracow University of Economics using Moodle platform majoring in Applied Informatics. The parameters of both models are presented in table 2.

Table 2 Model parameters in MASEM and Bayesian SEM models; Source: own

Paths and residuals	Estimate	P-level
	MASEM model	
UE	0.61	0.00
UB	0.64	0.00
Residual U	0.62	0.00
Residual B	0.58	0.00
Model goodness of fit	Chi-Square Value = 67.01, p=0.00, RMSEA = 0.078, CFI = 0.94	
	Bayesian SEM model	
UE	0.83	0.00
UB	0.27	0.00
Residual U	0.31	0.00
Residual B	0.32	0.00
Model goodness of fit	95% Confidence Interval for the Difference Between the Observed and the Replicated Chi-Square Values : 192.417 - 276.225, Posterior Predictive P-Value = 0.00	

The results show significant discrepancies between MASEM and BSEM models. It may suggest that parameters obtained in primary data research are biased due to a small and non-representative sample. Additionally, the direction of bias is clearly defined. The UE regression is upwardly biased and UB regression is downwardly biased as compared with the world's meta-analytic data.

5 Conclusions

The integration of meta-analysis and SEM models provides a powerful tool for a model generation and parameter check. TAM models are widely recognizable and used in the field of IT research. In the result of contrasting the "local" findings with the findings of meta-analytic SEM models, the

researcher gains an important knowledge concerning stability of model parameters, representativeness of the results and the direction of potential bias.

Acknowledgements

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The Introduction of the HR Manager Position in a Medium-sized IT Company

Lenka Svrčinová[1], Jan Ministr[2], Josef Fiala[3]

Abstract: The concept of "information technology" is currently understood as a field that is progressive from several perspectives including a financial view, a personal perspective and general expansion of the field in the world. Managers work only with numbers and they do not take into account the human side of IT that is represented by the employees of the company. A lack of motivation in the companies often leads to the situation when there is no qualified staff to work on a business plan. This article describes the situation before and after the introduction of the position of an HR manager in an IT company and it also includes the main benefits of this position.

Keywords: HR manager, top management, Human Resources, Quality

JEL Classification: M15, O22

1 IT Human Resources Management

The concept of the HR (Human Resources) manager has been quite underestimated for a long time in small and medium-sized IT companies. Due to the reaction to the current dynamic market, and constantly growing and more demanding competition, it is necessary to respond to market changes in a way that is better, faster and "painless" (Ministr, 2013). As a result, many companies have decided to invest in their employees through the so-called HR manager, or HR department. The concept of HR has been historically disgraced and misunderstood. Today, there is more seriousness attached to HR and its strength and influence on the running of the company is valued (Janišová and Křivánek, 2013).

Nowadays, companies are increasingly inclined to the idea of an internal HR manager instead of outsourcing staffing agencies in the search process for good employees. The reason is that a staffing agency searching for new employees has superficial knowledge of the running of the company and,

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unfortunately, ‘successful’ searching is accepted only when the attributes in a CV are in accordance with the requirements of a potential employer.

Thus the HR manager determines the position/person whose duty is to shape the company. They perfectly know business processes, personnel composition and they work with motivating people and determine the level of communication between the employees and the employer (Tvrdíková, 2015). The basic goals of the HR manager are:

- to fulfil and form a strategy of the IT company in following areas:
  - new employees - choosing and integrating new employees to the standardized processes of the company (position, salary, satisfaction),
  - current employees - working with existing structures, motivating and ensuring their satisfaction (company, finances, goals).
- **A communication channel between employees and owner/employer and vice versa,**

The HR manager is a bridge between the management of the company and its staff. Their responsibility is to transmit and assess information and the solution of initiatives from discussions (employee, management).

- **Change management in the company,**

In response to the changing market, there are also changes in processes, strategies, and strategic sub-goals. The HR manager ensures these changes in terms of process, resource and promotional levels.

- **Basic process optimization of the company,**

The HR manager fully understands the processes of the company and is a professional/expert who realizes their importance. But at the same time, being the expert or trained professional, they can optimize these processes (Hunka and Ministr, 2013).

- **Investment versus operating costs,**

Each prosperous company invests a part of its profits into the company, staff, training, benefits etc. At the same time, a financial plan/strategy for the running of the company is set up and it is necessary to observe it.

- **Shaping of the company culture,**

Each prosperous company has its company culture established that corresponds with the development of the company and the level of management.

2 Situation of the company before introducing the HR manager

Before introducing the HR manager, the arrangement of the IT company had to deal with the following difficulties at given levels of company management:

Top-level management

- Late or no response to the outflow of key employees (salary, prestige, a change of speciality etc.)
- The absence of predictions of company staff growth
- A lack of information of top management

Middle-level management

- Problematic changes of processes due to a lack of resource capacities
- The absence of HR competences and knowledge of middle-level management members.
- Accumulation of two roles belonging to one employee

Low-level employee

- The absence of a connection between top-level and middle-level management

Late response to the outflow of key employees

Each company in the area of IT has to deal with the problem of the outflow of key and good employees, especially nowadays. In terms of key employees, the company has to cope with the problematic period when they seek possibilities of substitutability and the distribution of the activities of key employee among others (Oškrdal and Doucek, 2014). This working procedure is possible to use; however, it has a negative impact on the quality of delivered services or solutions, which leads to a loss of customer trust (Danel et all., 2015).

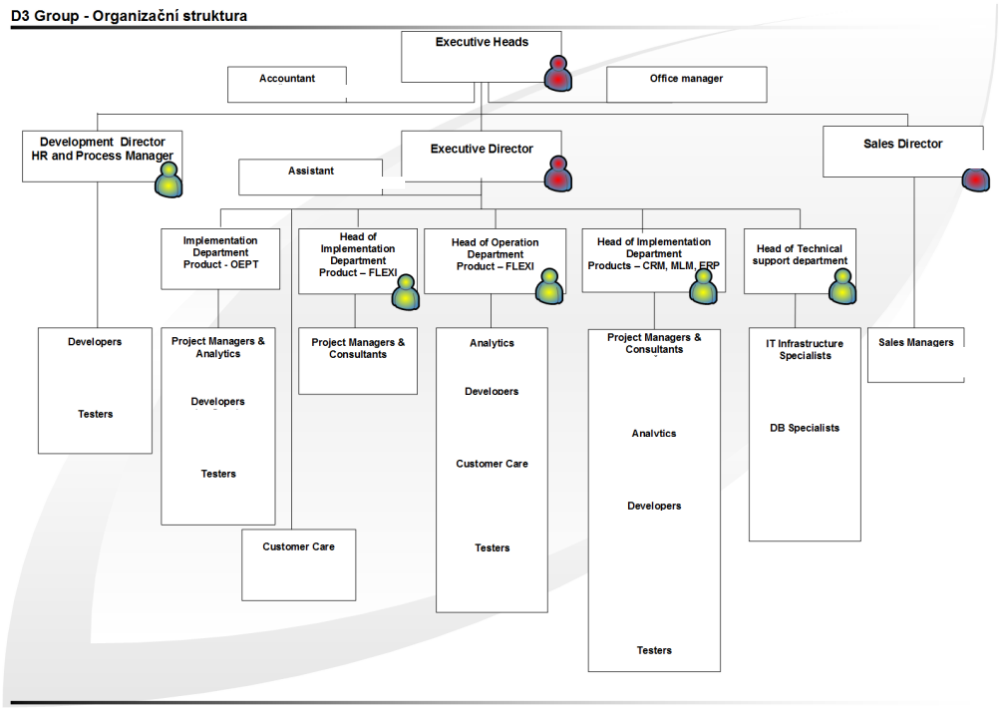
The absence of predictions of company staff growth

There was an inflow of new employees to the company due to new contracts or the implementation of new products for a customer. As a result, it is only a response to a new, unexpected market situation with IT solutions.

A lack of information of top management

Since the organizational structure has been changing for the 20 years of the company's existence, for example as a consequence of the increasing number of employees or the amount of software products, the current character of this organizational structure is formed as shown in the following chart:

Figure 1 Organizational structure, Souce: own



Problematic changes of processes due to a lack of resource capacities

Every IT company goes through processes of standardization when creating its internal methodology or when implementing a system, support or sales department. These particular areas are described in detail in the methodology (for example D3 Business Accelerators) of each company. Unfortunately, given processes and a capacitive load of individual processes are the problematic change processes - lacking an initiator (independent observer) and strategist (decision maker, capacity).

The absence of HR competences and knowledge of middle-level management members

The uniqueness of IT companies lies in the grouping of specialists with competences for management of projects, development, support or technical support for the development environment and the operation of applications. These specialists focus only on their specialization and thus the process of education in the areas of communication with employees, members of the team etc. is omitted. This means that their skills to work with people are often neglected, emotional intelligence (according to personality types) is not sufficiently developed and human relations and attitudes to employees are not fully appreciated at the expense of essential performance.

Accumulation of two roles belonging to one employee

Difficulties could be caused by the exaggerated participation of people in the recruitment process when middle-level management members hold the post of the HR manager. This is a result of the counterproductive activity when an IT specialist becomes an HR specialist.

The absence of connection between top-level and middle-level management

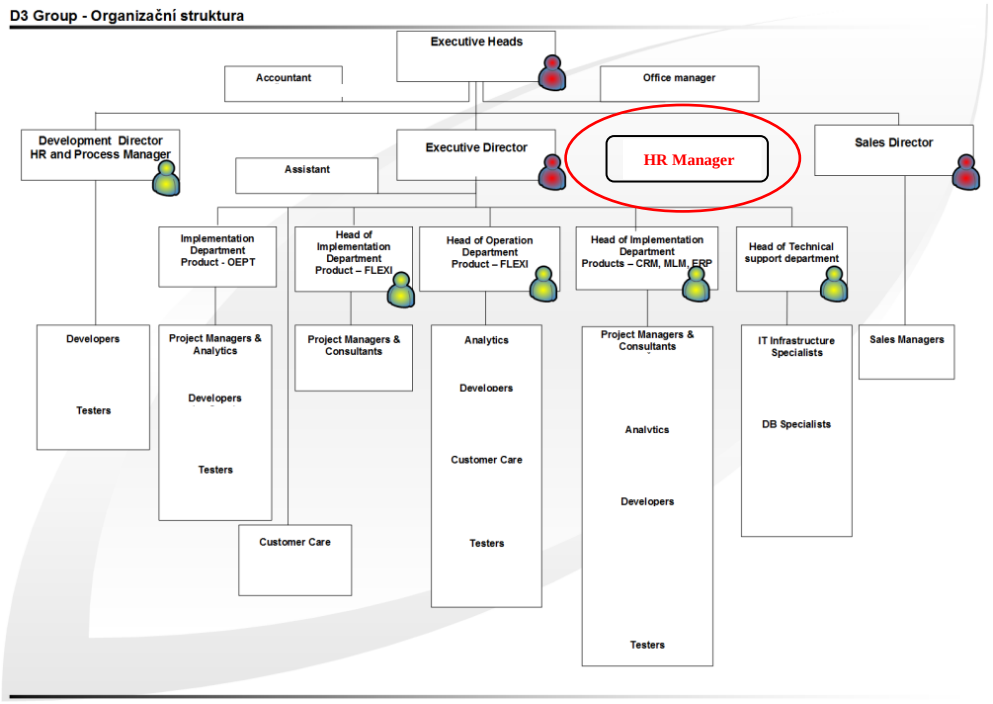
A department of top management comprising of the executive level through the middle-level of managers leads to the insufficient informing of top management from employees (mentioned above), but it also leads to the negative feeling of "separation" of direct communication of the employee with top management.

3 The situation of the company after the introduction of the HR manager

In terms of the aforementioned views to the problematic areas in the company, its management began to focus on solving current problems and invested in qualified specialists with long-term professional experience focusing on IT companies in the area of HR as an internal manager.

According to the organizational structure of the company, the position of the HR manager is at the level of higher management.

Figure 2 Organizational structure – new, Source: own



On the basis of the experience with human resources in the IT company D3Soft, key problems were identified for individual levels of management (Top-level management, Middle-level management and Lower-level employees) which are summarized in Table 1. There is also the recommended solution.

Table 1 Solution of problem, Source: own.

Area	Problem	Solution
Top Management	Late or no response to the outflow of key employees (salary, prestige, a change of speciality etc.)	Mind-mapping interviews are held at regular intervals and key employees undergo interviews at the level of top management, which is actively interested in their frame of mind.
Top Management	The absence of prediction of company staff growth	A personnel plan of company growth was compiled and gradually implemented. Employees have their given training processes and integration activities. At the same time, there is a set of criteria of a quality employee.
Top Management	A lack of information of top management	In terms of the HR manager position, meetings of company management are held at regular intervals where the HR manager presents their findings from interviews or activities in the company.
Middle Management	Problematic changes of processes because of the lack of resource capacities	The problem is solved by a personnel plan falling within the authority of the HR manager.
Middle Management	The absence of HR competences and knowledge of middle-level management members.	Middle-level management members have their educational plan in the area of HR under their supervision.
Middle Management	Accumulation of two roles belonging to one employee	Roles were exactly specified and separated according to the competences of individual employees.
Employee	The absence of connection between top-level and middle-level management	Existence of the HR manager role and their position in the organizational structure.
Employee	Unification of pay scale across job positions	The level of the negotiating skills of the HR manager.

4 Conclusion

The introduction of the HR manager position had a positive impact on the desired development of company processes in terms of ensuring quality human resources. On the basis of the anonymous survey which was carried out in the company, higher values of the metrics which are mentioned in the Table 2 were achieved.

Table 2 Evaluation of the contribution of the HR manager role

Metric	without HM	with HM
Satisfaction of employees	75%	86%
Outflow of employees Employee efficiency	14% 76%	11% 81%

Finally, the introduction of the HR manager position has a positive influence on company culture, which is valid not only for the area of IT companies.

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Cloud Computing in Management

Milena Tvrdíková[1]

Abstract. – This article aims to provide a comprehensive view of the challenges and benefits of the transition to a flexible architecture of an information system using cloud computing services for both parties in this process: the supplier and designer of the Cloud Computing solution, and the user. Emphasis is placed on the need for cooperation between the two parties. Analysis is made of the requirements for both sides in order to achieve the greatest possible benefit from this transition. The paper discusses the question of what to do if we want to maximize the effect of shared services in a company or organization.

Keywords: information system, management methods, flexible architecture, cloud computing, the effect of shared services, maximizing the effects.

JEL Classification: D22, O33, L86

1 Introduction

The use of advanced IT technologies is a significant element in the management process. There is an increased pressure on the ability of managers to immediately respond to changes in internal and external management conditions. Modern information technologies are an important tool for managers in their work. Without IT support, it is no longer possible to process huge volumes of daily generated data. Major trends in IT with an impact on the effectiveness and nature of management include transition to the use of IT as a service, conducting business using mobile technologies, increase in the requirements for IS security and increase in data volumes.

The above trends imply the need for a flexibly adjustable IS architecture.

2 Cloud Computing as an offer of shared services, providing for flexible IS architecture.

Cloud computing technology (CC) as a dynamic network service is currently one of the fastest growing information technologies required by managers. To ensure the necessary flexibility in management, managers require a comprehensive information system, which has to be dynamic and contain the

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necessary functionalities to different extents in different time periods. This requirement leads to a substantial increase in the use of dynamic network services. The CC services increase company flexibility and have a positive impact on its production and competitiveness. Companies providing CC services can cover almost the entire information technology infrastructure of a company, from hardware, running of applications, to data storage, organization structure and security (Tvrdíková, 2013). CC has no clear and uniform definition; each definition depends on the perspective on its author. "A cloud is defined as the combination of the infrastructure of a datacentre with the ability to provision hardware and software." (Sosinsky, 2011)

Gartner defines cloud computing as "a style of computing in which mass-scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies". Velte defines CC from yet another perspective: "Cloud computing is essentially a concept that allows you to access applications that are actually located elsewhere than on a local computer or device connected to the Internet, most commonly in a remote data center.", (Velte, 2011).

In summary, CC is simply a "Method of approach to the use of computer technology, which is based on providing shared computing resources and their use in the form of a service". The author of this paper relies on the definition of the US National Institute of Standards and Technology, which defines the CC as a "*model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources .... that can be rapidly provisioned and released with minimal management effort or service provider interaction*".

This definition can be used to derive the basic characteristics of cloud computing: self-service, broad accessibility, large quantity of resources, flexibility.

3 Management methods suitable for the management of the transition to IT as a Service

Currently, it seems appropriate to use some of the methods suitable for decision-making support under risk conditions – stochastic methods. Fuzzy methods designed for decision-making under uncertainty conditions do not seem sufficiently rational to solve problems related to information technologies. Most managers do not have deep enough IT knowledge and

experience to deliver the necessary information, and then use the results of fuzzy solutions.

The method which seems to be useful and widely used in practice (especially for its clarity to managers) is the stochastic method for decision-making under risk conditions, using the decision-making process in the form of a decision tree. The decision tree method provides greater clarity on the results of decision-making methods with a known probability of a decision-making situation. If this technique is used, the consequences of each alternative are more predictable, and the actual risk can be more effectively limited based on the knowledge of its sources and significance. However, if the decision-making entity is to cope with the negative consequences of decisions made under risk conditions, the graph must not be too complex, and therefore confusing (Mohelská, Pitra, 2012).

Once made, the implementation of the decision is always associated with organizational behaviour. It is accompanied by risks that may reduce the expected effect of the decision. These risks mostly involve those caused by individual errors of decision-makers during the preparation of the decisions, during the actual decision-making process, and in the implementation of its results. Threats accompanying the progress of the decision-making process are shown in Figure 1.

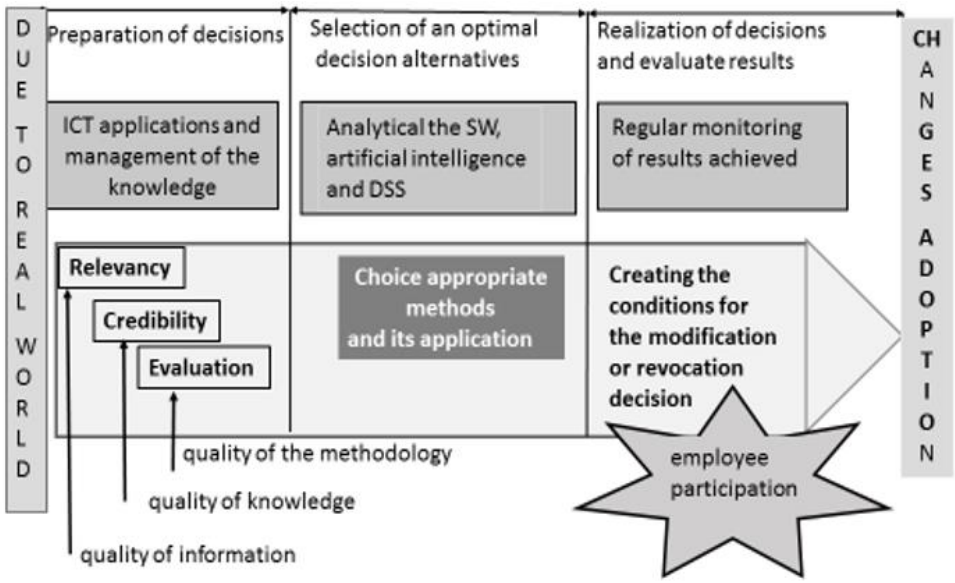

Figure 1 Risks accompanying the decision-making process [author].

4 Demands on suppliers of CC services

The decision to transform the entire company IT (or its part) to CC is part of the information strategy of a company or institution. The supplier cannot deal with the transition to CC without coordination with company managers. The current requirements for service providers arise from the rapid development of ICT and increase in the managers' awareness of ICT:

- Today, managers' requirements primarily include reduced delivery times, budget reductions and complexity of mutually integrated systems.
- The emphasis is on the mobility of solutions. Today's managers are used to working with a variety of mobile devices that they want to use while driving. Mobile applications can run anywhere; therefore, their mutual integration should be defined by standard interfaces.
- To accelerate solution delivery, there is an increased pressure on the use of innovative approaches, such as agile development or extreme programming.
- Increased demands on today's suppliers is due to the pace of change in the real world and in the actual ICTs (environment variability). The possibility of real-time data analysis becomes one of the most important features of the new generation of ICT infrastructure.
- Analytical tools integrated into network equipment allow recording the events on the network, monitoring its performance and detecting any anomalies. This allows a much more effective protection against possible attacks, but also optimize the network in real time.

Analytical tools based on big data and their real-time analysis then facilitate the development of applications for business intelligence and control of transmission networks. (BusinessIT, 2014). Growth in data volumes and the forecast of its development is shown in Chart 1.

Chart 1. Increase in the volume of data and its forecast 2013–2018.

5 Changes related to company management due to the transition to CC in user companies and organizations

An increasing number of decisions on the use of ICT will fall within the competence of the persons responsible for business processes and within strategic management. This will require changes in the qualifications required from managers.

- Managers who will be able to see how to use ICT to create a new product or service and how to find new customers will become indispensable members of senior management.
- Employees of the ICT department will have to be able to better clarify the value of ICT for business and offer new possibilities for the use of ICT in business. Solutions include the participation of CIO team members in all top discussions about company strategy, about changes in marketing and in business.
- As a result of operating applications in CC, companies will reduce the number of technology-oriented specialists (there will be less need for programmers, administrators and other professionals). However, there will be a growing demand for employees providing for the links between

business and ICT services (definition of requirements for ICTs, contractual relationships, formulation of SLA, monitoring of service delivery, etc.). However, not all of these workers will work directly in the ICT department.

Although the company will buy a number of ICT services from external suppliers, the total number of workers involved in the use of ICT in business will not decline. Only their qualification structure will be subject to change.

The company will have to reinforce key knowledge supporting the use of ICT in the company. How to use ICT to gain a competitive advantage, create new products or services, find new customers, speed up the company's response to external events and reduce the costs of business processes, all using ICT. This means supporting company processes by an appropriate selection of ICT services.

Managers must decide on further specifications – on the content, volume, quality and price of ICT services, on how to design the overall architecture of ICT services, which services, processes and resources to own and which to buy a service, how to find and select the optimal ICT service supplier, how to systematically inspect the deliveries of ICT services,

- determine the rules for the controlling of IT services and measuring the effect of ICT on the quality of company processes.

6 Positive impacts of the transition to CC services for users

Major positive impacts include:

Payment for the scope depending on use, rather than on costs, continuously, depending on how much shared services are used and what output, benefit or effect they provide. There are several specific pricing possibilities for their use, For example, monthly fee for the entire company or for a single user, or a price derived from the number of hours the service is used, or the number of executed transactions and other important tasks. However, these prices always directly reflect the extent of utilization of the services, and therefore indirectly their benefit and effect for the client. The prices are not determined based on costs necessary to operate the relevant technical solutions and their use for the provision of services.

The purchase of software applications as services at significantly lower prices than when purchasing licences. Sharing a single solution provided by the supplier to multiple companies with only minor modifications (multitenancy) allows the supplier to lease the applications at significantly lower prices than the licence prices.

A change in the cost structure of the user. When using shared services, there are no investment costs and the client only incurs operational costs. This results in the following additional advantages.

- Linearization of costs – while the investment component of the original costs was one-off and its linearization required intensive planning, in the case of shared services the total costs of the user are already linear by definition.
- Predictability of costs – by eliminating the investment component of cost, the client' costs become much more predictable. It also enhances their "output" character, which can be linearly dependent on the scope of the services used (i.e. it can also be flat and, therefore, constant).
- Measuring consumption – one of the benefits for customers is that shared service providers continuously evaluate the utilization rates of their services so that they can charge them correctly. Unless a flat fee is charged, the provider measures e.g. time spent using the application, the number of transactions carried out, etc. The users get a good overview of what their employees are doing and how they are doing it.
- The possibility to easily track the costs of each individual agenda – if the user costs were divided between investment and operating costs, the calculation usually did not include the costs of each individual agenda. It was difficult to distinguish the costs on an ongoing basis. Thanks to the manner in which shared services are charged, it is now very easy to get a detailed overview of the costs of individual agendas, which leads to
- Greater transparency of costs. This is because they only have one logical component, representing the actual use of the services. Originally, there was a number of items, often impossible to predict (e.g. costs of unplanned repairs, repair costs after an accident, the cost of adjustments following legislation changes, etc.).

CC takes away the detailed forecasting the company IT needs. The method to charge for the services, along with other basic characteristics of shared services, frees the users from having to predict in detail their needs in advance. They do not have to plan exactly how many employees they will have in a year or two, and plan the size of their IT accordingly. The scalability of shared services offers them the possibility to use these services to the extent that fits their current needs.

Benefits arising from the use of shared services reflected in the division of labour. In the past, users had to provide for all the activities themselves – implementing their own agendas, operating activities (care of their IT, systems management, application management), supporting activities (backup, ensuring the safety of IS), etc. More extensive systems required the company to be staffed accordingly. Thanks to shared services, this changes quite fundamentally; operational and support activities are effectively delegated to the service provider. Within the context of shared services, their users only use the capacities of the supplier's employees. A company only needs the employees who are essential for the performance of the actual agendas and tasks, i.e. the company's core business activities and activities using the company's proprietary know-how.

7 Conclusion

The users of IT transition to shared services so that they could benefit from a profit and be able to operate more efficiently, faster, and with better planning. They wish to concentrate more on their core business, their mission or the entrusted tasks and do not wish to be distracted by operational or other secondary activities.

To achieve the maximum effect of the strategy to transition to CC services, we must first prepare a timetable for the gradual strategic transformation of the overall IT architecture. In terms of management, this document is a strategic document.

It is followed by a specification of requirements which will be crucial in the choice of the contractor. Fundamental aspects include the time of delivery, the amount of cost, functionality, performance and complexity of the information system.

If the prospective IS is to be progressive, the specification should also include demands on the rate of mobility and alternatives of the required access to its implementation. At this stage, a specification is made of possible requirements for means allowing real-time analyses and the management of computer networks.

These steps are taught to managers in advance (by training, etc.) so that they can propose how to use ICT to improve the course and management of company processes, thus promoting the development of their own business. This means ensuring the participation of CIO team members in all top discussions about company strategy, about changes in marketing and in business. The qualification structure of employees is to be changed as necessary. The reason is an increase in the needs of employees ensuring the link between business and ICT services. Employees are to be trained in skills supporting the use of ICT in the company. Employees are to be prepared for the measurement of consumption – taking control over their work.

The specification of the contractual relationship with the supplier is to be focused on the provision of services (subject, functionality, objectives, expectations), service scaling (change of scope, quality, time of provision), ensuring connectivity (connectivity provider, connectivity downtime), the protection of personal and other sensitive data, the division of responsibilities between the company and the supplier, the legal status of physical equipment used to provide services, software licensing terms, conditions of system migration and required customization.

Current demands on the pace of life require the appropriate form of leadership. Leadership demands flexibility and information resources to support decision making. In order to maintain the quality of management at the highest level, it is necessary to use all the features of the existing information and communication technologies. The use of CC is one way to achieve this.

Based on the findings in the literature and the author's own practical experience with CC technology, the paper provides recommendations for the transition to CC in companies and institutions. These recommendations include a number of activities that need to be carried out to maximize the benefit from this change. Given the variability of current conditions, this paper calls for further research into this area to ensure increasing flexibility and quality of company and institutional management.

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Challenges of Managing a Project Team: Communication and Engagement

Renata Winkler[1], Marta Moczulska[2]

Abstract. The article discusses the functioning of project teams. Based on an analysis of the essence of a team and the special character of a project team, the meaning of transformation of a group into a team has been emphasized. Communication and engagement of team members are considered as challenges for project team management. Both issues are presented from the perspective of efficiency of a project team.

Keywords: group, teams, project teams, management, communication, engagement.

JEL Classification: L2, D2

1 Introduction

Owing to the degree of complexity of tasks and conditions of their implementation, organizations often use a team work organization. Furthermore, interdisciplinary teams have become a permanent element of the management practice in innovative and competitive companies. In practice, the creation of project teams is dictated largely by economic considerations. While creating a project team, an organization counts on its efficiency. This efficiency should be greater than in the case when a project is commissioned to a specific division or unit in an organization. Since cooperation in such teams is each time a challenge for the cooperating people, interest in the issues of project team management has increased.

The notion of a project team refers to a formally appointed group of people assigned to implement a project. A project is defined as an organized sequence of actions, aiming to achieve the intended result, within the confined period of time with the distinguished start and end, implemented most often in a team with the use of limited quantity of resources (Trocki (ed.), 2012, p. 19). Therefore, the essence of a project team is the implementation of a complicated

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and complex task, following the completion of which a team will be dissolved (Sikorski, 2013). Apart from the designated goal, time for its achievement [1] and determined resources, and thus purposefulness and limitation, projects are characterized by (Pietras and Szmit 2003): (1) non-repetitiveness, i.e. each project is different, new and considered as unique, (2) distinctness, which means lack of connection with the routine activities of a company, (3) structural distinctness, namely separation of project implementation as a separate structure in a company, (4) complexity, i.e. the need for division of a project into a number of partial tasks that require analyzing, decision-making, cooperation and communication of many specialists and use of various resources.

While deliberating on the functioning of teams, it is worth reminding the meaning and the essence of a team. A team is a group whose members have a common goal, and their actions are oriented on the achievement of this goal and they are responsible for this achievement (Griffin and Moorhead, 2011, p. 268-269). Each team is a group, but not each group is a team. A team is distinguished from a group by the specific character of social bond connecting persons belonging to this form of human community and by the adequate method of functioning. Team members declare their affiliation to a team (which is the case also for a group) and have the sense of co-responsibility for the implemented actions, and the willingness to cooperate with each other. Therefore, whereas in a group particular members perform mainly work individually, in a team they work on the goal achievement above all collectively (Puszcz et al., 2011). It means that action and performance (the effect of action) in a group depend to a greater extent on independent work of particular group members (individuals), while in a team they depend both on individual contribution of team members and their collective contribution.

In many cases project teams are composed of people who have never cooperated with each other, however their participation in a project is desired due to their knowledge, skills, and experience. Another commonly adopted practice is also a situation when some people are incorporated into work of a team only at a given stage of works on a project (e.g. to the order). Therefore, a team makeup throughout the project will be changed)[2]. The way of

[1] Depending on the level of complexity of a project adopted for implementation, this time is from several months to several years.
[2] In some cases it also refers to the so-called basic makeup of a team.

organizing a team alone and its work is often diverse. Some teams may work at one place and time, some teams may be dispersed spatially, and some teams perform tasks asynchronously. It may also happen that at the same time some people taking part in a project work on another project in another project team.

In the light of the above it can be concluded that, at the beginning of cooperation, a project team is essentially a group of people, but it is not a team (yet). It becomes necessary to transform a group into a team. It requires, first for all, that bonds between individuals taking part in a project be shaped and reinforced, which means, among others, that a respective level consistency between them should be built (Barinaga 2003). The subject literature emphasizes the meaning of appropriate selection of people who are to cooperate. Emphasis is put not only on the need to consider knowledge, skills and qualifications of future team members, but also their dispositions/social competences. On the other hand, efficiency of the existing (appointed) team depends to a large extent on the processes of team communication and engagement of team members (Costa, Passos, Bakker, 2014).

Both issues can be considered as challenges for efficient project team management. The paper is aimed to present them from this perspective.

2 Team communication

Most specialists agree that the process of direct and indirect communication affects work productivity and efficiency. Open, direct communication is of fundamental importance for building trust, climate of cooperation, creating common vision, loyalty, innovation, developing relevant thinking models, efficiency of learning processes. Inefficient communication may in turn undermine any efforts put in the actions related to shaping attitudes and interpersonal relations, training courses and professional training, and contribute to fixing and establishing wrong thinking and behavior patterns of employees (Senge 2002). „Communication errors" are an obstacle for real engagement of employees in the actions undertaken by organizations and reduce efficiency of use of complex forms of interaction and cooperation.

Efficient communication in a team usually does not appear naturally. Firstly, form, nature and course of the team communication process are largely dependent on type and nature of an organization; secondly, communication skills of team members affect their quality. Work in a project team is dynamic

and flexible. This type of work forces departure from the classic, formal pattern of communication. Instead of the formal vertical communication between superiors and subordinates and the horizontal communication between departments, project teams should have in place a system of transfer of information based on reciprocity and availability of information. Project team members are expected to have an open communication attitude, expressed by their readiness to communicate individually obtained information that is sought by other team members (Wasiela-Jaroszewicz 2008). Communication in project teams cannot function based on communication networks determined by the organizational structure. In project teams it is important to create specific communication channels. These channels may cover all team members or connect selected specialists comprising a team without e.g. the project leader or a certain group of members.

Efficient communication management in a team (next to team integration, development of mutual trust) depends on accurate diagnosis of communication needs of particular team members for the needs of their future satisfying. For this purpose, it is necessary to determine:

- *Who needs specific information*? It is advised to prepare respective lists of people with specification of the manner of organization of information for each of individual and acceptable level of detail of information. At the same time, it is important to recognize the existing knowledge barriers in potential information providers/recipients, who can be responsible for incorrect formulation or understanding, interpretation of a message. Therefore, it is recommended to develop procedures of analyses of message quality standard, both in relation to the degree of its adequacy and internal consistency of the communicated content, level of saturation with information, degree of comprehensibility, clarity and order.
- *Who should receive it*? Some elements that may prove significant are, e.g. the issue of "priority" of addressees, namely the determination when and in which sequence a particular type of information should be presented to individual participants of communication exchange.
- *How (and from whom) should it be provided*? In the communication process, apart from direct, face to face contacts (which, though considered as the most efficient, can be hindered for many reasons), depending on the needs, various communication media and techniques

can be used. While selecting the technique, the manager should consider: (1) the way the physical distance is shaped between the entities involved in communication interaction; (2) burden (among others, time burden) of the message recipients (for instance: more than a certain number of meetings a day may block the work of a given individual).

Additionally, each manager who aims at efficient management of communication in his/her team should settle also the following issues (Knapp, Knapp 2006):

- *How to gather and store necessary various data and information for the team? (How? Where? In which form?).*
- *How to correct and update data and information?*
- *Who will be responsible for these actions?*

He/she should prepare instructions concerning the method of updating, during the project implementation, the communication plan prepared by him/her (Phillips 2005).

3 Team work engagement

It is emphasized that employee engagement manifests itself in their effort and even dedication/devotion and enthusiasm towards work (Saks 2006). The level of engagement is reflected in the results achieved. In the opinion of K. Trus (Kular, Gatenby, Rees, Soane, Truss 2008), employee effort is a physical dimension of their engagement and involves two other dimensions: the cognitive dimension, concerning employee knowledge and assessment of work and/or work environment, and the emotional dimension, reflecting what an employee feels in connection with the above.

Team engagement is defined in the subject literature in two ways. In the first definition, team engagement is perceived through engagement of particular team members. Therefore, team engagement is a sum of engagement of its participants. The second one defines team engagement as "a shared, positive and fulfilling, motivational emergent state of work-related well-being" (Costa, Passos, Bakker, 2014, p. 418). This perspective converges with the presented team characteristics. Considering the above and the fact that work results of various teams are different, which results from the way of interaction of team members in order to perform the assigned task, the second definition of engagement has been adopted in the paper.

Knowing that team engagement is examined in the cognitive and emotional aspect, it can be stated that team efficiency will be determined main by factors associated with social interactions. It is necessary to emphasize an individual's attitude towards the group – its team orientation, namely whether an individual takes account of behaviors of other members and is focused on pursuing a common goal of the team more than of own goal. The more team-oriented members imply their greater effort, smaller tendency to conflicts, and therefore greater team engagement (Costa, Passos, Bakker, 2014). Tasks implemented are also important. They should be specific and feasible but, at the same time, ambitious and thus be a kind of a challenge for the team (Saks 2006). The way they are implemented, i.e. the degree of interdependence of team members in implementing their tasks also seems significant. Interdependence requires interaction and interaction is favorable for shaping of common perception of work and environment and creation of emotional bonds (Costa, Passos, Bakker, 2014). On the other hand, common organization of a given project means common determination of goals, common division of tasks (work), assignment of decision-making rights, determination of communication methods (what information, from whom and how – (Sikorski 2013)). What matters is thus co-decision-making. On the one hand, it contributes to the feeling of exerting impact and the sense of actions, while, on the other hand, to reinforcing believe in the achievement of common success. Both of them increase engagement (Saks 2006; Robinson, Perryman, Hayday 2004). Co-decision-making should cover also fixing standards, values binding in team work, which, apart from preventing conflicts, will enable team members to get to know each other (Costa, Passos, Bakker, 2014). It is important for mutual support during the project implementation and for "the contagion" of emotions. In this context, it is worth using positive feedback or celebrating small successes. Finally, the importance of the team manager can be emphasized: he or she, while taking care of engagement of his/her team members, should use participatory management, paying particular attention to interactions in his/her team.

4 Summary

Efficient project team management includes appropriate creation of the communication process and building of engagement of team members. As it has been presented, as part of communication it is worth recognizing

communication needs of particular team members for the needs of their future satisfying, creating a system of information transfer that would be based on reciprocity and availability of information as well as communication channels adequate to the needs of a particular task. On the contrary, in the case of team engagement, special attention should be paid to shaping social interaction. Work efficiency of a project team is fostered by joint action, including determination of goals, binding cooperation standards, division of tasks, interdependence in task implementation as well as celebrations of accomplishments, feedback and mutual monitoring of work and mutual support.

In the context of the drawn conclusions, it is worth adding that the presented actions foster shaping social bonds between team members and thus contribute to transformation of a group into a team.

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E-logistics as the ICT Innovation in Modern Organizations

Piotr Adamczewski[1]

Abstract. Increasingly use of ICT in logistics brings about dissemination of e-logistics and solutions used in its framework. Modern organization is based on organization-wide e-logistics of interconnected solutions primarily related to operations. By integrating these and other potentially critical business functions, organization is a powerful tool for integrating and managing information to ultimately drive greater business performance and efficiency. But like so many other aspects of information technology, organization is always evolving and successful ICT professionals are highly conscious of the need for credible information on the trends and innovations that are reshaping, and can and will reshape the landscape of e-logistics use and implementation. This paper discusses how to deploy advanced e-logistics in polish modern organizations.

Keywords: E-logistics, ERP, ICT, IoT, SMAC.

JEL Classification: A23

1 Introduction

The globalization processes of the world economy create the necessity to take fast and effective measures to adapt the operations of a modern organization to new market conditions. Advanced ICT solutions (*Information and Communication Technology*), which are the basic competitive factor of business organizations, are particularly open to the introduction of all types of innovation that may give a chance to increase the management efficiency. This fact contributes to financing subsequent research on new technologies and is the self-perpetuating mechanism of the search for innovative solutions. One of such areas includes the properly designed and applied logistics systems in modern organizations. Due to the use of modern ICT solutions within the application of advanced organizational-ICT solutions, they are called e-logistics (Grawe, 2009), (Wieczerzycki, 2012). The term means the broad application of the state-of-the-art ICT technologies to support management of business processes in a modern organization, e.g. within production, warehouse management, and order services as well as the management support

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with its business environment (in particular, the supply and distribution chains).

Economic organizations face the challenges of civilization and of the growing complexity of economic process relationships; therefore, they have to search for ways to adapt. Market mechanisms are characterised by high dynamics of changes in the economic environment, which requires systemic improvements within their management systems. Their adaptation is measured by the capacity to build up the competitive advantage in modern organizations using elements such as knowledge and intellectual capital of personnel, which should enable them to implement their development strategies. The key role in this respect is played by advanced ICT-based solutions within the information and communication infrastructure. They support business processes of such modern organizations by using advanced organizational and ICT solutions (Schwaninger, 2010), (Waltz, 2003). This implies the broad utilization of state-of-the-art ICT tools to support the management of business processes in an organization, e.g. in production, warehouse management or order services, as well as to assist in the management of its business environment (in particular the supply and distribution chains).

In the dimension of practical implementation, the applied ICT technologies are a mixture of hardware-software-organizational solutions, such as database and data wholesale technologies, communication technologies (wire, wireless, and hybrid), automatic identification methods (bar codes, RFID), computer aided manufacturing (CAM), supply chain management (SCM), enterprise resource planning systems (ERP), advanced planning systems (APS), customer relationship management systems (CRM), supplier relationship management systems (SRM), product life management systems (PLM), manufacturing execution systems (MES), warehouse management systems (WMS), satellite location systems (GPS, Galileo, Glonass), advanced business intelligence systems (BI), and the Internet of Things (IoT) (Vongsingthong, 2014), (Wieczerzycki, 2012). All these systems are implemented in a suitable data processing model (classical one or in cloud computing). Such technologies constitute a unique IT ecosystem, which enables to operate and develop advanced ICT solutions as attributes of innovation in modern organizations in the knowledge economy.

The aim of this paper is to give a presentation of the characteristics and implementation conditions of advanced e-logistics solutions based on state-of-the-art of polish modern organizations.

2 Advanced ICT Systems in E-Logistics

In practical terms the effective co-dependency of these elements means the necessity of the use of advanced ICT solutions within the framework of economic organization's ICT system. It uses technical, technological and organizational innovations appearing over the recent years. They comprise nearly all areas of logistic activity, from the development of the means of transport and equipment, through the organization and management of material and raw material flow to the development of structures of systems performing logistics processes. The area of their operation is **the implementation of virtual processes** in the environment of extensive ICT networks (most frequently the Internet is the technological platform) aimed at the coordination and integration of business partners in the supply chain (Graham, 2013).

As a consequence of organizational development, logistics services rendered by specialist outsourced organizational units have started to be offered most often by independent suppliers in the SaaS model (*Software as a Service*). Thus, the outsourcing market has developed, where a manufacturer or a processor is not encumbered with the costs of creating, maintaining, or updating the functionalities of ICT applications, which serve business relationships with partners in the whole logistics chain. In addition to compact services, modern solutions have appeared that combine a number of actions aimed at the coordination and integration of a network made of producers, wholesalers, retailers, distributors, transport, and forwarding firms. Suppliers of logistics services may organise the whole process of order fulfilment (from the time of its placing, through confirmation and delivery). In this case, they are called 4PL integrators (*Fourth Party Logistics*). They may also operate as specific e-markets, which associate available services to meet the demands of suppliers and customers in a chain of market goods deliveries. 4PL integrators serve the B2B **(***Business-to-Business***)** market and B2C contacts **(***Business-to-Customer***)**. As regards e-markets, the possibility of associating demand and supply of logistics services in real time is crucial, using the platform of generally available Internet tools.

In the increasingly complex economic conditions, ICT systems that increase incomes and optimise costs are valued most. Therefore, ERP systems (*Enterprise Resource Planning*) have enjoyed major popularity for a long time, both to serve clients and in the back-office area, without affecting directly the processes of selling goods and services. A well-configured ERP system may be a source of savings for any organization; moreover, it enables to take decisions faster and in a more flexible manner. In the times of economic crisis, organizational changes that stem from the correct use of information gathered by an enterprise about business processes and resources may be the cheapest way of their development (Graham, 2013), (Magnier-Watanabe, 2009).

In the last few years, investments in ICT equipment have been growing dynamically, which means that great many economic organizations have already purchased suitable IT infrastructure that may operate efficiently in the next few years. At this point, therefore, they may focus on buying business software, such as ERP. The foundation for a success in an enterprise is the ability to plan and achieve business objectives consistently. This task is the more difficult the faster an organization develops. ERP systems are ICT systems that integrate all aspects of a business operation. Advanced ERP systems enable to collect data concerning the on-going operation and, primarily, transfer it into knowledge necessary to take right business decisions. On the other hand, enterprises that already use an ERP system should invest in modules that will increase its functionalities. The most commonly recommended ones are the solutions designed for sale and purchase management processes, because they make it possible to standardise the buying process while using the economies of scale, which is especially important for organizations of distributed infrastructure. On the other hand, enterprises that decide to take brave competitive actions need to have tools that will make it possible for them to carry out detailed analyses of information coming from the market.

The application of Business Intelligence tools enables to understand preferences of customers better and to analyse sales results in order to eliminate less profitable products and activities (Graham, 2013), (Koronios, 2010). Analyses conducted based on information aggregated by ERP systems often underlie most business initiatives in numerous enterprises. Even the simplest solutions may prove useful, as they enable to estimate operational risks and limit potential hazards that result from problems of organizations that

are situated within a shared supply chain. The economic crisis will contribute to creating closer links between businesses that operate within supply chains, due to the necessary exchange of services and process integration. Additional benefits will follow within the synergy effect. The analysis of enterprise operations is the key element of strategic management. Having complete knowledge, an organization may take right decisions and, consequently, improve its competitive position. Owing to the immediate access to valid data, the management/directors have knowledge that enables them to raise the working efficiency of specific departments in an enterprise. After all, in the situation of strong competition on a market, decisions taken in the area of management affect the market position most.

Enterprises that develop dynamically focus more on the flexible and modern ICT solutions with extended analytic functions. Analytic modules should provide fast access to current data, reporting and comparing results of the enterprise. It means that ERP systems have to be provided with standard reports but also with their easy generation for the needs of an end user. Access to contextual information important for different users, which should guarantee the coordination of daily business activities with the general strategy of an enterprise should also be an important functionality of a system. Considering the implementation of a modern ERP system, one has to take into account the changes an organization is subject to, for example those related to its development, employment, growing demands, and the extension of sale markets. Therefore, it is a good idea to choose flexible systems that enable the prompt modification and extension with new components facilitating the adaptation to individual user expectations. A well-thought-out decision concerning a selected ERP system will make it possible to gain substantial savings in the future, as the needs of the enterprise in this respect will increase. Therefore, a selected ERP system should be sufficiently scalable and flexible. It should be characterised by the maximally simplified service interface. Preferably, it should be accessible via any website browser. Finally, its implementation should be fast, while simple modifications should be available without the necessity to change a source code.

Other ICT technologies face new challenges, e.g. within the automatic identification, wireless connectivity, and satellite localization (Grösser, 2012). The current fashion for SOA (Service Oriented Architecture), virtualization, and WEB 3.0 may turn out to be one of the development factors of investments

that are well related to business processes. Already the 1990s showed clearly that without an ERP system there is no modern management in an enterprise. The recent years have revealed that the traditionally understood ERP systems are no longer sufficient. Their basic functionality has been enriched with the following modules: CRM (Customer Relationship Management), SRM (Supplier Relationship Management), SCM (Supply Chain Management), and PLM (Product Lifecycle Management) [Adamczewski, 2015), (Magnier-Watanabe, 2009). The last extension, in particular, has gained special importance. The management of product lifecycle management encompasses actions starting from the moment a concept of a product appears until its withdrawal from the market. It consists of the development of a design concept, the creation of production technology, manufacturing management, documentation management, and customer order management. An important element in the PLM system is the service of technical changes of products in production and supply processes. In case of high series manufacturing with a large number of variants, where a buyer may customize a product model and its fittings, it is important to apply a product configurator. It enables to create a product model, as-built documentation, material lists, and cost estimates. These objectives can be fulfilled owing to the collaboration with CAD/CAM packages (Computer Aided Designing/Computer Aided Manufacturing).

The latest ERP versions utilise fully the cutting-edge ICT solutions, including the above-mentioned SOA concept. This service is understood here as a separate functional model and treated as an element of an ICT solution that fulfils a specific task. The independence of such services makes their use possible within any system platform and programming language. It gives unprecedented possibilities within the flexibility of activities and the development of ICT solutions. Interrelated enterprises serve streams of materials and semi-materials, semi-finished products and finished products as well as information associated with such processes within supply chains. To fulfil such objectives in an orderly and repeatable manner, workflow systems are utilised. When supported with the SOA philosophy, they enable to put into practice the idea of an enterprise within the RTE (Real-Time Enterprise) convention. Objectives set for such solutions are as follows (Koronios, 2010), (Schwaninger, 2010):

- management of transactions within a sectoral supply chain;
- just-in-time planning and delivery of supplies;

- the fulfilment of sectoral criteria of a supply chain (monitoring products during all phases of their manufacturing); and
- offering detailed profitability and customer service analyses including flexible reporting.

3 SMAC-systems in E-logistics

The dynamic advancement of ICT has led to the development of a new technological standard, namely SMAC systems, which make it possible to implement new business models. They are based on four pillars (Vongsingthong, 2014):

I. Social – social media remove barriers in the information flow among people and become platforms that enable the fast exchange of knowledge, which is becoming more and more effective. Communication within social media is strongly displacing telephone and e-mail communication. This phenomenon is also taking place in business, where the fast exchange of information is essential. The use of social media makes it possible to gain better interaction with customers, which facilitates faster reactions to problems and building the knowledge base according to user preferences and behaviour. Employees may meet in the social media to exchange their experiences and interesting content much faster and quicker, thus accelerating the resolution of problems.

II**.** Mobile – mobile devices such as smartphones and tablets have become an indispensable part of our lives. They have also opened up new opportunities of reaching customers who use mobile devices and have become accustomed to shopping and using different types of services and applications regardless of time and place. The growing popularity of mobile services has also forced entrepreneurs to develop their e-marketing and to provide customers with mobile channels. In such conditions, the presentation of an offer of mobile devices is the foundation for gaining and maintaining a strong market position.

III**.** Analytics – the understanding of behaviour and preferences of customers is among the greatest advantages that comes with using analytical tools. The collected data analysed with advanced algorithms can be used by entrepreneurs to understand how to earn loyalty of their customers, enhance marketing campaigns, improve product development processes, and render

services that meet preferences and requirements of their customers. By learning preferences of users, entrepreneurs can present content that meets their expectations. Therefore, the key objective in using analytical tools in business is to take right decisions according to updated and aggregated information.

IV. Cloud – the cloud computing technology offers tools that enable to collect information effectively and manage a business efficiently. By using tools available in a cloud organizations are able to reduce ICT costs, break geographic barriers, and gain access to data at any time and place. A cloud is a factor that puts other SMAC components together.

There have been numerous examples in recent years that show the discrepancy between expectations and the actual benefits that come from the use of ICT tools. The cause of this effect may be the lack of the adequate level of integration between implemented systems. The key to success with the SMAC technology is the combination of the above-mentioned four technologies that communicate and thus provide the economies of scale. None of the four technologies alone can give a full effect. Only the synergy created by all SMAC elements working together makes it possible to create a competitive advantage. So far, organizations have invested in mobility, cloud, business analytics, and the use of social media in business by creating independent and usually incompatible solutions. Their combination within the third platform makes it possible to create new services that generate incomes, deepen relationships with customers, and improve the efficiency of organization operations.

Owing to the development of the computing cloud and the mobile technology, it has been possible to move from closed communication systems to social platforms (Magnier-Watanabe, 2009). As a result, the work system and business communication have been changed deeply and permanently. Social channels make it possible to create and give access to content quickly, distribute information on a larger scale, and to cooperate and interact with customers better. Mobile technologies have given easier access to information with non-stop online connectivity. Data analyses are used to optimise customer relationship management and improve sales channel efficiency. A cloud, on the other hand, is the foundation of ICT systems in many enterprises, improving their flexibility, scalability, and cost savings of data processing.

Organizations that want to maintain their position on a competitive market have to be ready to provide customers with tailor-made services. Owing to the SMAC development, ICT technologies are not only the support in business development, but in fact a turning point that gives an advantage to organizations and enables them to stand out against the competition. SMAC provides the required information on time, which makes it possible to take right decisions and cooperate effectively both inside and outside an organization, i.e. in the whole cooperation chain.

4 Internet of Things in E-logistics

New ICT technologies, e.g. in the scope of automatic identification, wireless communication, satellite localization or Internet of Things are facing a new challenge. The Internet of Things is a concept according to which unambiguously identifiable items may indirectly or directly gather, process, or exchange data via a global network. Such items comprise, for example, household appliances, lighting and heating installations. The term was used for the very first time in 1999 by Kevin Ashton and since then it has undergone quite an evolution. It is sometimes applied interchangeably with a term "Internet of everything", which describes a network of people, processes, data and intelligent connected to the Internet. The term was created by CISCO Company and has been currently replaced by a term "Internet of Things" (Höller, 2014), (Vongsingthong, 2014).

Over the last fifty years, ICT has been subject to two key transformations. The first one took place in 1960s and 1970s together with the appearance of solutions supporting automatization of processes, designing (CAD) and manufacturing resource planning (MRP II). The second transformation was the result of the emergence of the Internet and associated solutions. It is assumed that the Internet of Things shall be a driving force of the third wave of changes.

The IoT is such a popular concept that it leaves much room for interpretation. The term can be used to describe any unambiguously identifiable thing able to - indirectly or directly - gather and process data. The number of such devices grows dramatically together with the number of possible applications. The IoT is closely associated with the *big data* area - as its largest benefit is the efficient gathering and processing of large amounts of

information (Perera, 2015). Three features distinguishing the Internet of Things comprise context, ubiquity and optimization. The first one refers to the possibility of advanced interaction between the item and its surroundings, immediate response to the changes, etc. Under this feature, the items provide information on, for example, location, physical or weather conditions. Ubiquity corresponds to the fact that today there are more things of this kind (items, objects) than people connected to the network. In the near future they will communicate with each other on a large scale. Optimization stands for functionality of each thing (item, object).

The Internet of Things is a concept that is both fashionable and leaves large space for interpretation. This term can be used to describe in fact each and every explicitly identifiable object that is capable of, directly or indirectly, collecting and processing data. The number of such devices keeps growing dramatically, likewise the number of their potential uses. The big data area is closely related to this solution, as the effective collection and processing of large volumes of information are among the greatest benefits offered by IoT (Höller, 2014).

Three characteristics that distinguish the Internet of Things are context, omnipresence, and optimization. The first quality refers to the possibility of advanced interaction between a thing and the environment and its immediate reaction to changes, etc. Within this characteristic, things supply information, e.g. about localization, the physical status or atmospheric conditions. The omnipresence reflects the fact that already today the number of things (objects) is greater than the number of people connected to the global network. In the near future, they will communicate on a large scale. Optimization is the expression of functionality that is brought by each and every thing (object). Owing to the spread of Internet of Things, such solutions are becoming an integral part of each and every product. Sensors, processors, and their specialist software are integrated into their functionality (they in fact become their *sine qua non* condition) and are combined with the advanced data analysis. This leads directly to the creation of new and improved products (services), which enables the visible jump in economic efficiency (Perera, 2015).

As regards the Internet of Things, the formulated expectations are still relatively modest, because such solutions are only beginning to reach Polish enterprises in the practical dimension and, as every novelty, are accompanied

by information noise. However, there is a popular opinion that IoT may significantly define the logistics chains and affect their conduct substantially, both in temporal and cost terms.

Due to popularization of the Internet, such solutions become a standard, integral part of each product. Sensors, processors and specialized software are incorporated into their functionality (and in fact become the condition sine qua non) and become combined with advanced data analytics. It leads directly to the creation of new and improved products (services), thus allowing for noticeable leap in economic efficiency. According to some forecasts, the third wave of economic transformation, fueled mainly by the ICT development, will be probably the most significant in history. It will entail even more intensive development of innovation and productivity as well as faster economic growth. The Internet of Things opens new perspectives, for example, within the scope of "instrumentalization" or use of smart devices to collect data, monitor and analyze products of both, a given organization and a business process. The appropriate use of sensors connected to network may provide each organization with large amounts of useful information by means of real-time reading of statuses of things (objects) used for better comprehension, analysis and planning of operational activities (Höller, 2014).

According to ICT analysts, the nearest future holds a real increase in the popularity of solutions using the Internet of Things. The increase will be mainly generated by the consumer market, which is swamped with more and more smart devices: such as wristbands assisting in training or smart, network-connected refrigerators, smart TVs, smart watches, smart utility meters, 3D printing of ready products at the customer/recipient, etc. The first devices meeting the requirements of the IoT were highly specialized and applied mainly in the industry. These were, above all, different types of sensors and readers, whose task was to collect data from production infrastructure and forward them to control systems. Currently, these requirements have been expanded with the possibility to connect to a global network via an individual IP address, e.g. information on technical condition of a car and communication with a service engineer or a manufacturer, and the possibility to automatically generate orders of shelf products by reading their minimum stock number with a sensor.

Research conducted in Report PMR shows that (Report PMR, 2015):

- nearly 90% of logistics and transport companies already implement or will implement the IoT solutions in the coming year,
- over half of respondents expect that the IOt will have positive impact on supply chains,
- 40% of respondents expect that IoT will help their companies to increase safety and cost effectiveness,
- it is assumed that the key technologies assisting the implementation of the IoT are Wi-Fi, safety detectors and NFC (*Near Field Communications*),
- nearly 40% of respondents pointed out to privacy and security as the biggest obstacle in the implementation of IoT solutions,
- 38% points out to complexity of the said solutions and resulting risk associated with their implementation.

The aforementioned research results show how important the IoT is for logistics and transport companies. Such solutions provide operational data on location and monitoring of things (objects). Owing to that information it is possible to improve the quality of customer service by shortening logistics processes and their cost optimization.

5 ICT Development in E-logistics

The development of advanced ERP systems stimulates the demand for supporting the above-mentioned ICT analytic tools within business intelligence. Such solutions contribute to the effective support of decision processes. The so-called business analytics is becoming an increasingly common topic (Graham, 2013), (Koronios, 2010). It covers tools and applications used to analyse, monitor, model, present, and report data that support decision taking. To this purpose, data wholesales, supply chain operational analyses, analytic CRM systems, in-depth financial analyses, and efficiency indicators of enterprises are utilised. Users of such solutions work on a strategic level of enterprises, based on certain data aggregates. This is related to the problem of data integration and synchronization. Data integration starts from the potential to use numerous data sources, both via dedicated interfaces and the use of standard ODBC mechanisms (Open DataBase Connectivity). Data may come from relational or hierarchical databases, structural files as well as from ERP systems. Therefore, such connections should make it possible not only to read data but also to record and process

them. In case of most enterprises, there are numerous ICT environments and access mechanisms should make it possible to obtain data from different platforms (as far as possible without the use of intermediate files).

ERP/BI solutions are not subject to fast changes, but phenomena have developed that may affect this class of application software fundamentally. They include (Graham, 2013), (Koronios, 2010), (Perera, 2015):

- the widespread use of network enterprise solutions,
- the growing business importance of mobile solutions,
- the increasing flexibility of ERP systems owing to the more and more flexible solutions with other applications and mobile devices, provided with functions known from social media,
- the growing use of a cloud computing model in ERP systems, which is particularly important in case of the SME sector (costs lower by up to 20% are a main incentive),
- the increasing interest in ERP sectoral systems (they shorten the time and cost of their implementation), within which the targeted solutions of a specific problem occur with the functionality limited to the service of a single business process (maximum a few processes), giving fast return on investment,
- the general departure from functional models in favour of serving specific business processes, which in the ICT dimension constitute the reflection of information services, and
- the spread of Internet of Things – in such solutions smart devices are used to read statuses in real time.

According to studies carried out by the author1, such solutions have been applied already in 49% of surveyed entities (or there were specific plans of their use) and were selected mostly due to benefits they provide, which can be presented as follows (percentage in the surveyed population) (Adamczewski, 2016):

- the effective access to ICT resources – 57%,
- focusing on business processes rather than on the maintenance of ICT infrastructure – 25%,
- lower costs of ICT solution operation – 19%,

[1] In 2014-2016, the study encompassed the representative sample of 120 enterprises from Mazowieckie and Wielkopolskie voivodeships (Poland).

- the availability of highest class technologies without investments – 12%, and
- the flexibility of cost accounting – 10%.

To supplement such results, it is noteworthy that only 10% of respondents excluded the application of this processing model, while almost 80% preferred global suppliers of such technologies. Undoubtedly, the cloud computing market is one of the fastest growing segments of the ICT market in Poland now. The number of customers taking advantage of cloud solutions has been growing, boosting vendors' revenue. The private cloud is the prevailing model. The Polish cloud computing market continues to grow at a very fast pace. The development of the cloud computing market is driven by several factors. However, the popularity of such solutions primarily results from financial (a change in the manner of charging users for supplied cloud services) and business factors (greater flexibility in business operations).

6 Conclusion

The accelerating technical and economic-social advancement and the growing dynamics of changes and the related uncertainty are becoming important conditionings for the operation of modern economic organizations. Such organizations, in order to counteract such uncertainty, have to exhibit considerable flexibility as the basic attribute of organizations in the integrated development. A decisive role in this respect is played by advanced ICT solutions of e-logistics.

The demand for advanced ICT of e-logistics solutions that support business processes in modern organizations will keep growing, because such organizations, due to the nature of economic activities, are interested in the optimum use of their resources in order to gain maximum benefits from the invested capital. The growing offer of ICT solutions available on the Polish market enables organizations to make a selection depending on their business needs and financial capacities, while ICT support of the whole chain of supplies is becoming not only a challenge of a competitive market but in fact the necessity to meet the growing demands of clients in the area of their effective service. When production and ICT technologies are similar, the sources of competitive advantage are to be searched for in effectively designed and efficient advanced ICT solutions of modern organizations, which gains

even more importance considering the growing demands of market mechanisms of the knowledge economy within integrated development.

The growing popularity of an integrated approach to economic development and holistic thinking should be promoted by the confrontation of theoretical inspirations with real needs and possibilities of stimulating integrated economic development in the globalization conditions and the inevitable transformation to knowledge economy. Hence, it is becoming necessary to look at such conditionings and dimensions of integrated development from the angle of challenges faced by modern organizations.

Modern ICT solutions of e-logistics using the so-called 3rd ICT platform, i.e. Mobility, Big Data, Cloud computing and Social Business (media) contribute directly to the increased efficiency of business processes, hence raising the competitiveness of organizations on the global market. Therefore, it is important that they should be analysed holistically, which will guarantee the final effect of synergy.

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Optimization and Planning of Logistics Flows in Industrial Printing Production

Tomáš Barcůch 1

Abstract. This Project focuses on the Logistic Flow Optimization and Planning in Industrial Printing Production Plant. The aim is to design and develop a solution enabling to plan production process in a manner that avoids the overflow of warehouse capacity and at the same time does not compromise the existing level of customer services. The theoretical part describes the matter of industrial production logistics and management. The practical part then analyses the current situation from the perspective of logistic flows in the Moraviapress rotary offset printing works in Břeclav. I used the available data to analyse production and warehouse capacity, taking into account its expansion in relation to the implementation of a new production machine. The thesis is concluded by the evaluation of results and the specification of indicators for warehouse capacity in order to ensure its optimum use and predict its overflow.

Keywords: Transportation; Material Logistics Flows; Logistics Controlling; Logistics; Manipulation; Optimization; Polygraphy; Prediction; Rotary Printing Offset Machines; Storage of Unfinished and Finished Products.

JEL Classification: D20

1 Introduction

The printing industry is now facing competing technologies for communicating information not only in the Czech Republic but worldwide. In virtually all areas we can see an effort to transfer, store and archive information in the form other than printed. With the growth of storage capacity and affordability of reading and archiving technology, the volume of printed media constantly decreases dramatically. The only area that this segment is currently benefiting from is the production and printing of packaging materials, where the advertising, marketing and legal reasons and growing efforts to communicate information about uniqueness, quality and composition of the product to the purchaser. Printing capacity in the market largely fulfils promotional leaflets at the expense of quality magazine production. For journals, reduced quantity increases the costs of a lot of parties' reach of the

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advertising message. Overall, however, this method of advertising also recedes due to the Internet. Virtually every publisher has its products on the website, some even left the printed medium completely. That decreases the amount of funding in this industry, printers had and still has to fight for survival. Since the prices that publishers are currently willing to pay for the production of printed material shave fallen by more than a half for the last 20 years, large printing corporations undergo adequate restructuring consisting of a reduction of costs, starting with extensive measures to reduce personnel costs through investments in efficient automation and optimization of their logistics process ends.

2 Optimization of logistics flows in printing plant

- The company Moraviapress decided in 2014 to install the aforementioned web offset printers MAN Roland (Figure 1) and its share of the volume of printed output is between 55 and 60 %.

Figure 1 MAN Roland Lithoman IV year of manufacture 2014,

Source: Manroland web systems, 2016

- The data in Table 1 for the year 2014 show that the volume of processed products rose by 98 % compared to 2013 and the company increased production capacity by as much as 140 %.

	2013	2014	increase
Paper usage [t]	30 200	52 801	75%
Tint usage [t]	742	1 667	125%
Printed pages [mil A4]	6 393	12 675	98%

Table 1 Comparison with indicators of consumption and production,
Source (Moraviapress s. r. o., 2016)

3 What was to optimize

The main expectation and goal of this project have been to meet the proposal, and if it was prior to the conclusion of this project possible, also to implement optimization of identified critical points. The result of certain measures was fully evaluated until the second half of year 2015, when was again expected a seasonal increase in production volume. An important contribution at start of 2015 is that the company has had the option, for example, before the planned expansion of dispatch hall, to find out whether and how the vision will be fulfilled during one year manufacturing and thus predict possible overloading of material logistics flow. On the basis of this information it could then decide the best time to start construction. Within three months of construction, the undertaking to prepare for two of the three loading ramps and the entire process of loading and expedition was in a provisional situation when there was no scheduled production restrictions. Prediction of overflow, however, already showed that in the planned three-month deadline for the implementation of extension threatens the completion of at least one of the warehouses and so could, already almost two months before its realization, prepare an emergency plan for this period so that negative impacts has been minimized.

4 Analysis

The first optimization measures concerns the fact that there is often no longer an autonomous analysis of the situation in the field. Here, by the effect, when the mere need to describe the current workflow and formulate simple reason of the workplace often brought to the responsible persons to think, rethink and possibly immediately optimize their activities in connection with the surroundings and the aim of the project.

In the planning it was found that long-term planning of periodic orders does not overload storage capacity. To know of the operative intervention in the production plan, which take place in a maximum of two weeks. But usually weekly and even daily in advance. So rapid changes are not necessarily difficult to predict. Their management takes place operatively and provides a flexible response by the entire logistics process immediately when the situation arises. In this case, the lack of a significant lack of transparent planning software that could clearly visualize the production process, for example, the Gantt chart provided logistical methods using quick response (WebFinance,

2016). It is arguable that support production planning from the perspective of information systems greatly underestimated areas, which makes it difficult to optimize the company already in the very beginning of production planning as well as in input analysis and data collection.

Some of the recommended solutions that carry the high acquisition costs, were designed to be implemented from the budget in the future. This is the automatic handling of pallets and RFID identification (Falkenhahn AG, 2016).

Also worth mentioning is the newly created application loading plan and the expedition which may in the future serve as a functional analysis for implementing solutions to the new ERP system. Or, in ArchiCAD we can create an exact plan of handling and storage areas, which makes it possible to accurately determine the capacity and then evaluate the new state after adjustments handling paths.

5 Conclusion

To work on a project for the optimization of logistic processes in rotary offset printing works, there are no studies or references that would address this issue in this industry. Due to the significant competitive environment, the majority of such projects are handled without special publishing. However, if we assume that well-known definitions and rules for the optimization of logistic processes are applicable to any manufacturing process, it can be expected that neither the printer of this type nor its size will be an exception.

When announcing the intention to launch this project, I was initially embarrassed by intuitive access to initial analysis over time, as I began to clarify certain outcomes from subsequent heuristic analysis; there were changes in results of both the project sponsor, the leadership of the company and on the part of interested colleagues. Some of the findings were surprising, such as too large a share of industrial areas or roads calculate potential savings in storage space appears when fully loaded pallets. These simply realizable optimization proposals were initially underestimated as insignificant but that changed after the quantification of specific indicators.

In conclusion, we can say that the project to optimize logistical flows in the Moraviapress printing works unexpectedly encompass a wide scope of activities of the company. It turned out that logistics is really "hit" and in one unit connected to each article of business processes. In this work,

unfortunately, it is not possible to list all related and very interesting projects that resulted from tasks that were affected by the project or, on the contrary, that it themselves affected. These included moving trucks due to better organization of loading project for unattended vehicles entering the business premises using license plate readers and other tools. Predictors for overflow storage capacities and thus extending the project to optimize logistical flows are certainly not finished and are currently still ongoing and it is possible to predict long "life".

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MPNP: Petri Net Processes Modeling and Simulation Tool for Mobile Devices

Martin Čechák[1], Ivo Martiník[2]

Abstract. Petri nets is one of mathematical modeling languages for the description of all kind of parallel systems. Petri net processes are ordinary connected Petri nets with a unique entry place, a unique exit place and a set of places for handling resource sharing with their initial marking allowed. This article introduces MPNP programming system that is the first tool designed for modeling, verification and simulation of Petri net processes that will run in the mobile devices environment. It is developed in the Java Gluon programming environment and it is fully portable among mobile devices with iOS, Android or MS Windows operating system installed.

Keywords: Petri nets process, simulation, parallel system modeling, mobile devices, MPNP.

JEL Classification: C63, C88

1 Introduction

Petri nets (David and Alla, 2010), (Diaz, 2009), (Reisig, 1998), (Reisig and Rozenberg, 1998) is one of mathematical modeling languages for the description of all kind of parallel systems and they represent a popular formalism connecting advantages of the graphic representation of a modeled system with the possibilities of its simulation and the formal analyzability.

Property-preserving Petri net process algebras (PPPA) (Huang et al, 2012) were originally designed for the specification and verification of manufacturing systems. PPPA also follows many ideas that can be originally seen in the class of workflow nets (van der Alst and van Hee, 2002). The elements of PPPA are the Petri net processes, an ordinary connected Petri nets with a unique entry place, a unique exit place and a set of places for handling resource sharing with their initial marking allowed.

MPNP is the first tool designed for modeling, verification and simulation of Petri net processes that will run in the mobile devices environment. It is

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developed in the Java Gluon programming environment (Java Gluon, 2016) and it is fully portable among mobile devices with iOS, Android or MS Windows operating system installed.

2 Petri net processes and their main properties

Let $\boldsymbol{N}$ denotes the set of all natural numbers, $\boldsymbol{N_0}$ the set of all non-negative integer numbers, $\varnothing$ the empty set and $|A|$ the cardinality of given set A, $\neg$ the logical negation operator.

P/T Petri net (PN) is an ordered 5-tuple $PN = (P, T, A, AF, IF)$, where P is a finite non-empty set of places, T is a finite set of transitions, disjoint from P (i.e., $P \cap T = \varnothing$), A is a finite set of arcs (flow relation), $A \subseteq (P \times T) \cup (T \times P)$, AF is the arc function, $AF: A \rightarrow \boldsymbol{N_0}$, $AF(x, y) \in \boldsymbol{N}$ iff $(x, y) \in A$, $AF(x, y) = 0$ iff $(x, y) \notin A$, and IF is the initialization function (initial marking), $IF: P \rightarrow \boldsymbol{N_0}$.

PNs represent a popular formalism connecting advantages of the graphic representation of a modeled system with possibilities of its simulation and the formal analyzability. The system is then described with a bipartite graph containing a finite non-empty set of places P used for expressing of the conditions of a modeled system (we usually use circles for their representation), a finite non-empty set of transitions T describing changes in the system (we usually draw them in the form of rectangles), a finite set of arcs A being principally oriented while connecting the place with transition or transition with place and we usually draw them as lines with arrows, the arc function AF assigning each arc with a natural number (such number has the default value of 1, if not explicitly indicated in the net diagram) expressing the number of removed or added tokens from or to the place associated with that arc when executing a particular transition and the initial marking IF expressing the initial status of the modeled system with so called *tokens* considered as mutually unidentifiable and we usually represent them in the form of small circles in particular places of the net. Initial marking is then visualized as $IF(p)$ tokens in place p ($p \in P$).

Some commonly used notations for PNs are $\bullet y = \{x \mid (x, y) \in A\}$ for the *preset* and $y\bullet = \{x \mid (y, x) \in A\}$ for the *postset* of a net element y (i.e., place or transition). *Marking* M of the PN PN is a mapping $M: P \rightarrow \boldsymbol{N_0}$. Marking M then

express the current status of the modeled system. If $P = \{p_1, p_2, \ldots, p_n\}$, where $n = |P|$, marking M can then be written as a vector $M = (M(p_1), M(p_2), \ldots, M(p_n))$.

As it has been stated, with PNs not only the current status of the modeled system can be detected, but dynamics of transitions between its individual states, too. Transition $t \in T$ is *enabled* in the marking M of the PN PN if at each input place of the transition t is in the marking M at least as many tokens as required by the value of the arc function AF of the particular input arc of the transition i.e., if $\forall p \in \bullet t$: $M(p) \geq AF(p, t)$. If transition t is enabled in the marking M of the PN, we denote that fact symbolically in the form of t ***en*** M. *Firing of the transition* $t \in T$ itself consists in the removal of as many tokens from each input place of the transition t as required by the value of the arc function AF of the particular input arc of the transition t, and adding of as many tokens into each of the output places of the transition t as required by the value of the arc function AF of the particular output arc of the transition t i.e., it results in changing the marking M into the marking M', where $\forall\, p \in P$: $M'(p) = M(p) - AF(p, t) + AF(t, p)$, that is denoted by $M\,[t\rangle\, M'$. The set of all markings reachable from the marking M we will denote by the symbol $[M\rangle$.

Let PN $PN = (P, T, A, AF, IF)$. We will denote that PN PN is:

- *ordinary* iff $\forall (x, y) \in A$: $AF(x, y) = 1$;
- *live* iff $\forall M \in [IF\rangle\ \forall t \in T\ \exists M' \in [M\rangle$: t ***en*** M';
- *deadlock-free* iff $\forall M \in [IF\rangle\ \exists t \in T$: t ***en*** M;
- *k-bounded* iff $\exists k \in \boldsymbol{N_0}\ \forall p \in P\ \forall M \in [IF\rangle$: $M(p) \leq k$.

A *Petri net process* (PNP) is an ordered 3-tuple $PNP = (PN, p_e, p_x)$, where $PN = (P, T, A, AF, IF)$ is an *ordinary* and *connected* PN; $p_e \in P$ is an e*ntry place*, it is the only place $p \in P$ such that $\bullet p = \varnothing$; $p_x \in P$ is an *exit place*, it is the only place $p \in P$ such that $p\bullet = \varnothing$. A PNP will be also denoted by an ordered 7- tuple $PNP = (P, T, A, AF, IF, p_e, p_x)$.

Let $PNP = (P, T, A, AF, IF, p_e, p_x)$ is a PNP, $P = \{p_e, p_1, p_2, \ldots, p_n, p_x\}$, $n \in \boldsymbol{N}$. Three special marking can be defined:

- *static marking* $M_s = (0, M_s(p_1), M_s(p_2), \ldots, M_s(p_n), 0)$, such that $\forall t \in T$: $\neg(t$ ***en*** $M_s)$;
- *entry marking* $M_e = (1, M_s(p_1), M_s(p_2), \ldots, M_s(p_n), 0)$;

- *exit marking* $M_x = (0, M_s(p_1), M_s(p_2), \ldots, M_s(p_n), 1)$.

Figure 1, illustrates the PNP *PNP1* = (*P*, *T*, *A*, *AF*, *IF*, p_e, p_x), where *P* = {Pe, P1, P2, Px}, *T* = {T1, T2, T3}, *A* = {(Pe, T1), (Pe, T2), (T1, P2), (T2, P2), (P1, T1), (P2, T3), (T3, P1), (T3, Px)}, *AF* = {((Pe, T1), 1), ((Pe, T2), 1), ((T1, P2), 1), ((T2, P2), 1), ((P1, T1), 1), ((P2, T3), 1), ((T3, P1), 1), ((T3, Px), 1)}, p_e = Pe, p_x = Px, in its static M_s, entry M_e and exit M_x markings (note the place P1 with the initial token in the static marking M_s and the fact that no transition must be enabled in (any) static M_s or exit M_x markings).

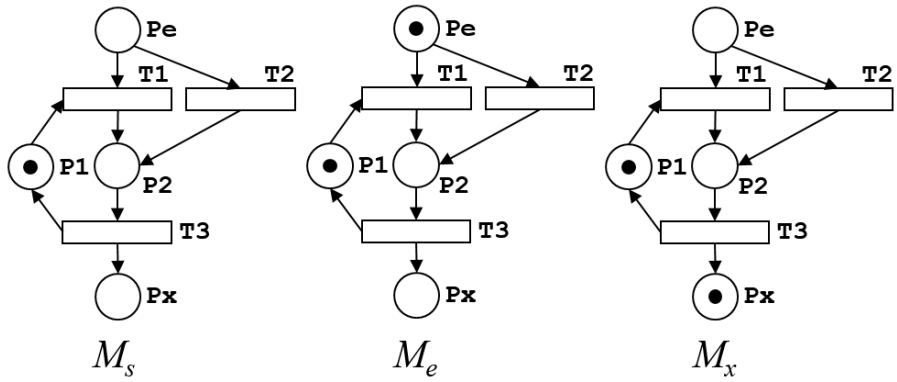

Figure 1 PNP *PNP1* in its static, entry and exit marking.

Property-preserving Petri net process algebras (PPPA) were originally designed for the specification and verification of manufacturing systems. The elements of PPPA are the PNPs. Among other features, PPPA does not need to verify composite components because all of their operators preserve many properties. PPPA have five types of operators: extensions, compositions, refinements, reductions and place-merging. All the operators can preserve about twenty properties (some under additional conditions), such as liveness, boundedness, reversibility, traps, siphons, proper termination, etc. Hence, if the primitive modules satisfy the desirable properties, each of the composite components, including the system itself, also satisfies these properties.

3 MPNP tool for modeling and simulation of Petri net processes and its main properties

MPNP is the first tool designed for modeling, verification and simulation of ordinary PNs and PNPs that will run in the mobile devices environment. It has been developing in the Java Gluon programming environment and it is fully

portable among mobile devices with iOS, Android or MS Windows operating system installed. It consists of Petri nets engine and portable mobile Petri nets desktop editor and simulator (see Fig. 2).

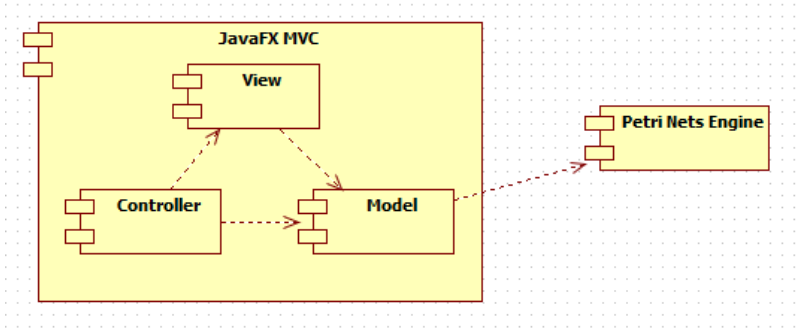

Figure 2 MPNP Petri nets GUI application for mobile devices

It is possible to state the following main features of the MPNP Petri nets engine (see Fig. 3):

- simulation step by step (stepping, debugging);
- real-time simulation;
- analysis in aspect-oriented manner (customizable analysis of a state of given Petri net before and after each transition occurrence);
- possibility of injecting custom reactions to a Petri net via callback functions;
- fully separated from the rest of the application, i.e., strongly encapsulated behavior;
- communication via methods like `addPlace(String id)` and `renamePlace(String currentId, String newId)`.

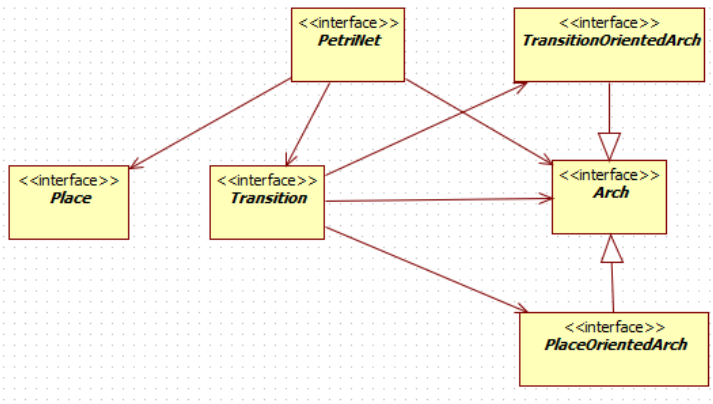

Figure 3 MPNP Petri nets engine design

Portable Petri nets desktop editor and simulator application (see Fig. 4) was built with the support of modern and powerful JavaFX framework, yet written in concise and world-wide used programming language, with the following main properties:

- well-arranged user interface with rich customization capabilities;
- high-quality rendering of shapes such as circles, rectangles, arcs or Bezier curves and also very fast rendering compared to the easiest solution, i.e., web browser application;
- with the help of Java Gluon ability it can be easy port on Google Android or Apple iOS platforms;
- strict framework compliance to the Model-View-Controller architectural pattern that helps with the transparency of the whole application;
- user interface customization for the mobile devices;
- there is a MPNP version for the desktop operating systems only, however JavaFX framework has in-built support for events such as touch or swipes, so the user experience on mobile devices will not be just a "desktop application on a tablet".

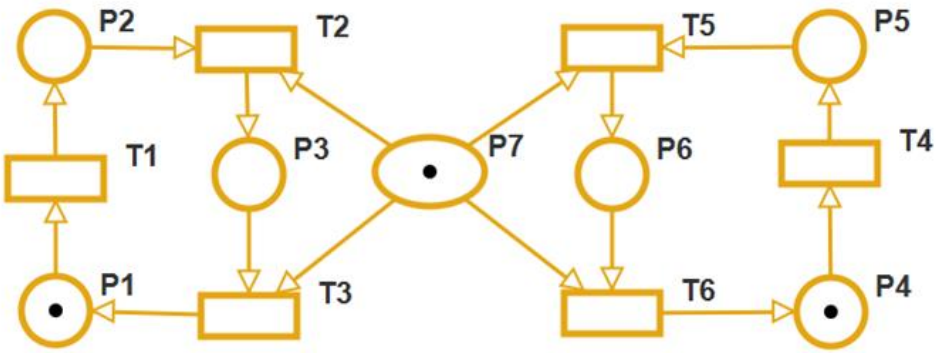

Figure 4 MPNP Petri nets editor and simulator

4 Conclusion

PNP represents typically a method in the model of the programming system realized with the support of the Petri nets formalism. Petri nets processes and PPPA can be thus successfully applied at design, modeling, analysis and verification of generally distributed multithreading object-oriented

programming systems. The next step in the development of the MPNP programming system will be the implementation of chosen PPPA operators functionalities and the possibilities of their application for individual PNPs.

The principles introduced in the PPNs can be further generalized and implemented in the definition of a class of high-level Petri nets called the sequential object Petri nets (Martiník, 2015) specially determined for the design, modelling and verification of object-oriented and functional programming systems.

Acknowledgements

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Transactions in Business Process Modeling

Frantisek Hunka [1], Jaroslav Sevcik [2]

Abstract. Transactions usually form the basic building blocks for business process modeling. Principal parts of these transactions are human beings. Agent or actor role are notions that are usually used for them. The aim of the paper is to describe and demonstrate on a particular example the possibilities of Design Engineering Methodology for Organizations (DEMO) and Resource-Event-Agent (REA) methodology. The DEMO methodology can be regarded as a generic methodology having its foundation in the theory of Enterprise Ontology; the REA methodology is regarded as the domain specific methodology and has its origin in accountancy systems. The outcome of these approaches is that the DEMO methodology captures everything that happens in the reality with a good empirical evidence whereas the REA methodology captures only changes connected with changes of economic resources. Economic events represent either change of the property rights to economic resource or consumption or production of economic resources. This results from the essence of economic events and their connection to economic resources.

Keywords: transaction approach, business process modeling, REA model, DEMO.

JEL Classification: L14, L23, M11, O21

1 Introduction

Most of the business process modeling methodologies simply originated form ‘best practice’ without a vigorous theory from which the methodology is derived. They mostly focus on production actions, which are usually described as an event that happens instantaneously or over a period of time. Generally, the most recommended notation of business processes is an UML activity diagram with swim lines (Chang and Ingraham 2007), (Zacek and Janosek, 2015). Each swim line represents actions or activities of a human being. Human beings are an inseparable part of business process modeling (Dietz, 2006), (Zacek and Janosek, 2014). However, the absence of a vigorous theory means that business process modeling approaches suffer from various incompleteness (Ministr, 2013). DEMO methodology (Dietz, 2006), (Dietz,

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2012) stems from the theory of Enterprise Ontology which represents a generic approach to business process modeling. The benefit of this methodology is that it perfectly identifies principal transactions that create a business process including human beings. It also provides necessary abstractions that enable capturing the essence of the modeling reality. On the other hand, this methodology is designed to be generic, which means that it only registers production activities and is aware of them but without any other processing them.

The other methodology we are dealing with is the REA methodology. Its name is derived from three fundamental concepts, namely: Resources, Events and Agents. This modeling approach originated from accountancy systems but was developed into a fully-fledged tool for business process modeling, see (Geerts and McCarthy, 2006), (Dunn, Cherrington and Hollander, 2004). Economic resources are things of economic value that have utility for economic agents and for that reason they are planned, monitored, and controlled. Examples of economic resources are money, raw materials, labor, tools, products, and services. Economic events are activities within an enterprise that represent either an increment or a decrement in the value of economic resources. Some economic events occur instantaneously, some occur over time. Examples of economic events are sales of goods, rentals, and provision and use of services. Economic agents are individuals or organizations that participate in the control and execution of economic events. Examples of economic agents are customers, vendors, employees and enterprises. The basic REA pattern can be extended by commitment entities which are determined to work with future events. This construct is known as REA model. However, this paper doesn't deal with REA model but it only focuses on REA pattern.

The structure of the paper is as follows: In Section 2, indispensable essence of the DEMO methodology is described. The essence of the REA methodology is presented in Section 3. Section 4 addresses demonstrating example. Discussion and conclusion is included in Section 5.

2 DEMO Methodology

According to the DEMO methodology (Dietz, 2006), (Dietz, 2012), an organization is composed of people (social individuals) that perform two kinds

of acts, production acts and coordination acts. The result of successfully performing a production act is a production fact. An example of a production fact may be that the payment has been paid and accepted, or the offered service has been accepted. All realization details are fully abstracted out. Only the acts and facts as such are relevant, not how they are achieved. Communication acts and facts together with production act and fact constitute a transaction pattern which is depicted in Fig. 1.

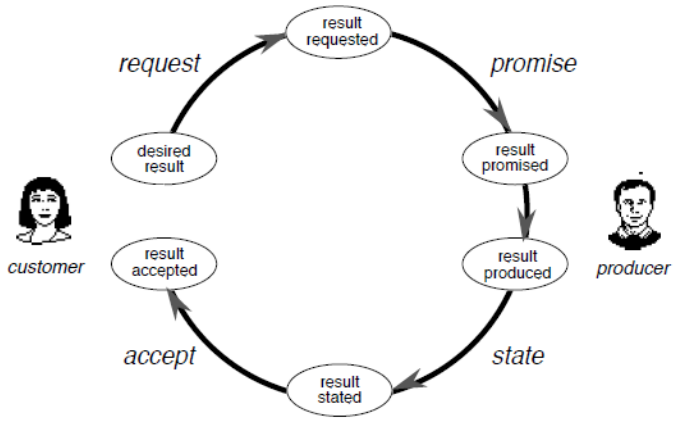

Figure 1 Basic transaction pattern – happy path (Dietz, 2006)

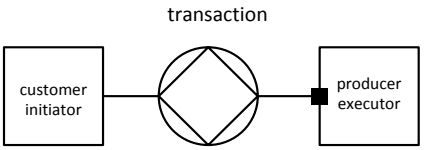

Figure 2 DEMO Transaction – basic building block (Dietz, 2006)

The transaction axiom states that any transaction follows a precisely specified pattern; there are certain state transitions and rules that specify allowed and exclude forbidden state transitions. The transaction axiom contains two subject roles, the customer (initiator) and the performer (executor), and coordination and production acts that result in coordination and production facts between both subjects. This pattern includes only the so-called "happy path" of the transaction. Each transaction starts with the request coordination act made by the initiator. In response to the request (represented

by the fact requested), the executor performs a promise coordination act. This coordination act results in the coordination fact promised. The promise goes on in a production act, which results in production fact. The production fact brings about the coordination act state which results in the coordination fact stated. The coordination fact stated causes the coordination act accept which results in the coordination fact accepted. This pattern solidly describes business processes and representing them according DEMO ontological methodology. The DEMO transaction pattern also describes three principal abilities of partaking actors. They are authority, responsibility and competence. Authority is something that is given by other subject to the specific actor role. Conversely, actor role has responsibilities for its coordination acts and facts to the superior subject. Responsibility is mostly manifested through coordination acts and facts. Competence means exclusively the capability to carry out production acts and facts.

3 REA Methodology

The main benefit of the REA approach is the ability to keep track of primary and raw data about economic resources. This explains why the REA approach offers a wider, more precise, and more up-to-date range of reports. In its basic form, an REA transaction is represented by an economic event, an economic resource and a pair of economic agents (Chang and Ingraham, 2007), (Geerts and McCarthy, 2006). The economic event represents an event that happens or has happened in the past. Contrary to the DEMO methodology with one sided transaction, the REA core pattern is composed of two kinds of transactions, see Fig. 3. REA transactions are related to each other by a duality relationship which is located at the operational level. In order to model future economic events, an REA model has to be extended with the policy level. This level contains commitment entities, contract entities and resource type entities. In short, a resource type entity represents a category item whereas a resource entity represents a physical item.

The REA core pattern captures the basic activities during exchange of resources. This pattern is composed of two transactions which are mutually joined by the exchange duality relationship. This relationship is considered to be the essential feature of this core pattern. Each transaction is composed of an event entity (e.g. Money Receipt or Sale), a resource (e.g. Money or Pizza) and a pair of economic agents (Mia's Pizzeria and Customer). The economic agents

are the same in both transactions. The claim entity is a temporary entity which is used to balanced differences between different transactions. For instance, a customer receives pizza but the payment for pizza may be done by invoice.

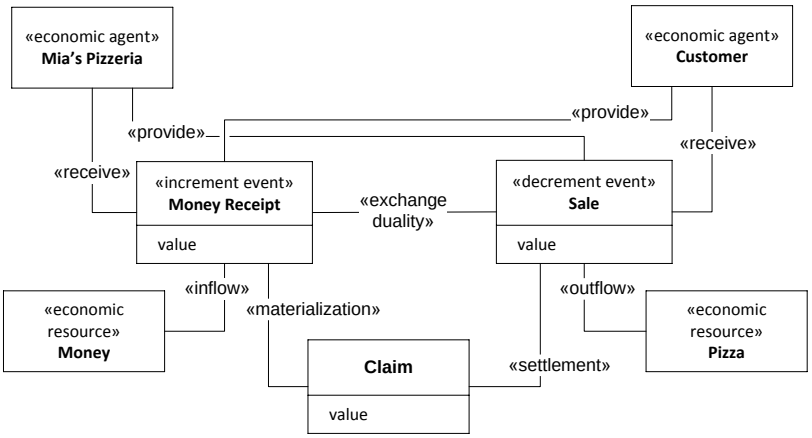

Figure 3 REA core pattern source (Dietz, 2006)

4 Demonstrating Example

This example describes electrical energy supply and shows the basic models in both methodologies. At the very beginning, a client signs a contract about electrical energy supply. The contract contains all necessary conditions and rules that concern electrical energy supply. Consumed electrical energy has to be paid by the customer in the form of invoices. The period for invoice payment is usually one month. Usually once a year, the real electrical energy consumption is ensured by reading the meter. If the customer had spent more energy than he had paid, the difference in payment is included in the next invoice payment. In case the customer had spent less electrical energy that he had paid the customer's next payment is reduced by the not consumed amount of energy expressed in money. The electrical energy payment is composed of the network charge and real energy charge. In the course of time, both the network charge and the real energy charge can change.

The DEMO solution expressed in the construction diagram is shown in Fig. 4. It contains eight transaction and related actor roles. Each transaction brings a specific result which follows:

- B-T01 Contract concerning electrical energy supply was signed;
- B-T02 Meter reading was provided (by a customer);
- B-T03 Invoice was paid;
- B-T06 Network change was specified;
- B-T08 Meter change was specified.

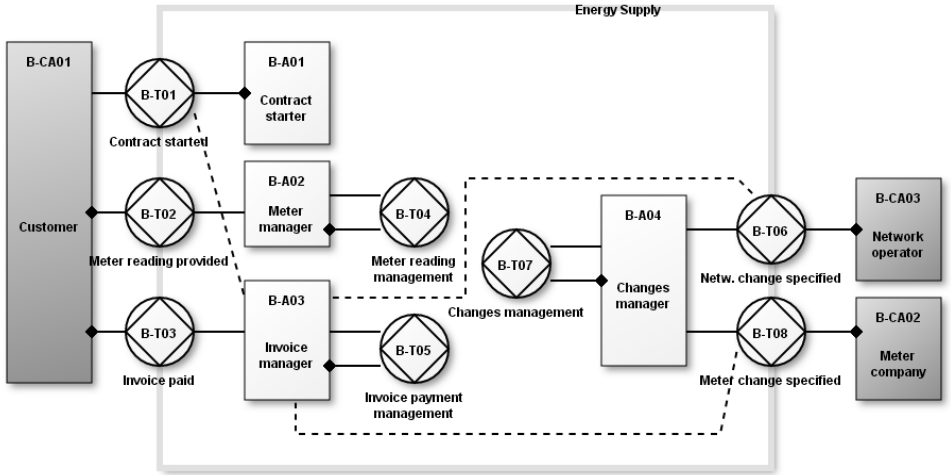

Figure 4 The DEMO Construction model of electrical energy supply

The other three transactions, namely B-T04, B-T05, B-T07 are so called self-activated transactions. These transactions are activated in specified period of time e.g. once a month and cause initialization of related transactions.

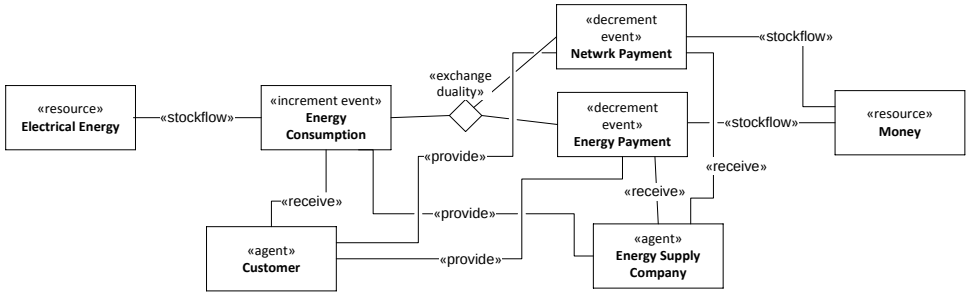

Figure 5 REA model of exchange process

REA model is shown in Fig. 5. This model only captures so called increment and decrement economic event. Increment event in the view of the customer means that he receives electrical energy and provides money for

network payment and energy payment. The DEMO approach clearly demonstrate that the capability of the DEMO methodology is to capture "everything" that happens in the modeling reality. REA approach, on the other hand, is only focused on changes of resource's values more precisely changing of property rights between different agents.

5 Conclusion

The main aim of the paper was to illustrate possibilities of a generic methodology comparing to capabilities of the domain specific methodology. Illustrated example clearly depicts that the DEMO methodology is able to capture all events that happen in reality with good empirical evidence. Contrary to, the REA methodology only focuses on events that are connected with change of properties to economic resources or to consumption or production of economic resources.

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The Methodology of Process Analyst Verification Using the Implementation of Specific Information System

Vladimír Krajčík[1], Pavel Vlček[2]

Abstract. The article focuses on process management in public administration using the specific case study of the statutory city of Ostrava. Based on the selected part of the PAPRIS methodology, the process management is verified, and conclusions from the application of information system e-SMO ("Electronic Statutory City of Ostrava").

Keywords: PAPRIS, E-SMO (Electronic statute city of Ostrava), Call center, process modeling, public administration, back office.

JEL Classification: D83, L15

1 Introduction

In the open information society the public administration authorities have an opportunity to draw from the findings and experience that numerous productive, non-productive, profit, and non-profit organizations have acquired in the sphere of process improvement for several decades (Grasseová, 2008). Process management is one of possible tools for further economic growth in the organization. In public administration sector it means the introduction of such changes that will lead to:

- increase in public administration efficiency, i.e. to a higher service quality provided in accordance with the status of individual public administration bodies,
- error rate reduction,
- acceleration of service delivery (citizen request processing),
- cost-reduction of provided services (Vlček, 2006), (Vlček, 2009).

The project e-SMO is a good option. The information system e-SMO ("Electronic Statutory City of Ostrava") represents a modern and attractive way of communication between citizens and authorities. Fast, reliable and

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clear operation of citizen's requirements is given thanks to the option of using the Internet, telephone and other elements of communication used for dealing with the public authority. The eSMO is a tool that should make transactions provided by public authority easier. From a technical viewpoint, the communication between citizens (the ICM structure and IVR scripts) and the e-SMO is designed in such a way that, in case of the further expansion, there will not be necessary to change the logic of the functional units. Only modular expansion, from the citizen-client's viewpoint the expansion of user units, is performed. Depending on the dialled telephone number a script, which controls the behaviour of IP Call Centre, is selected (Vlček, 2009).

2 PAPRIS Methodology

The selected parts of this communication system will be verified using the PARRIS methodology. The PARRIS methodology (PAPRIS – Process Approach - Public and Regional Information System) (Krajčík, 2013), (Krajčík, 2014) is based on defined process categories that are described in the procedural elements of project management methodologies. Furthermore, it is based on general principles and characteristics of the procedural approach to project management of information systems, and on the principle of system categorization as well.

2.1 Goal Formulation Process and Output Process

The project's process goal is in accordance with the PAPRIS methodology and it is defined for the IS final state, which was chosen by the control body in the IS project. We can categorize it according to the level of abstraction, time horizon, the degree of openness, and by its content. Its design and implementation have been coordinated.

2.2 The Process of Defining the Project Purpose

The project purpose is an information requirement that is viewed as a goal defined in the broader context of the generated process output which is part of the IS. That means that the project area, expressing a reason or a requirement on the information output existence, as the IS needs it. The process function reacts to the purpose, says what it has to be filled with. The process is, as part of the IS project, transparently and clearly justified. It is defined why and for whom it exists and what it has to provide. The formulation of the process

function is done in accordance with the principle formulated in the PAPRIS methodology.

2.3 The Process of Specification of the Strategic Planning Process

The intentions are based on the project's vision. There is a clear idea about for how relatively long time the process, in its particular form defined by the IS, will realize its mission and fulfil the imaginations of the contracting authority. The strategic aims are concretized by the strategic objectives of the IS process. They are measurable and determine the range and the time period in which the aim should be fulfilled. The other processes defined in a dynamic perspective are directly linked to this process.

The strategic aims define long-term interests of the contracting authority as well as the final output from the IS. So, this process can be understood as a basis and guide for the formulation of the sub-aims.

3 Processes within the PAPRIS Methodology in the e-SMO Application

Processes are designed as legally independent - describing possible technological channels that are operating as a part of the e-SMO project. Possible legislative restrictions, in the sphere of mutual communication between the client and the Statutory City of Ostrava (SMO), which result from individual agendas, are taken into account within each agenda – only the channels that are in compliance with agenda legislation are always selected for agenda communication. Currently it includes all the major technological possibilities established in the market.

Communication between the client and the SMO represents one of the major benefits and features of the e-SMO project. The project includes the following communication channels:

- Call Centre - authorized and unauthorized access,
- Web Portal - authorized and unauthorized access,
- Information Booth - authorized and unauthorized access,
- SMS Gateway,
- Reservation System Counters - only authorized access,

- Client Notification System (Vlček, 2009).

Individual agendas are designed in such a way that the technological possibilities of individual communication channels are maximally supported and fully used.

The results of these changes are following:

- Increasing the effectivity of the clients' requests processing
- Increasing the clients' awareness in relation to individual agendas – i.e. increasing the clients' awareness of the course of individual agendas processing, the required documents, contact information and, last but not least, increasing the clients' awareness of the status of request processing.
- Minimizing the number of personal visits in the SMO / ÚMOb offices
- Taking into account the clients' preferences regarding the communication with the SMO.

Possible changes of communication requirements resulting from the legislative changes in relation to individual agendas are considered individually in each agenda, and therefore, they are not objects of this support process (Vlček, 2005).

The change of clients' preferences for individual channels can be expected – as the citizens' access to the Internet, mobile technologies and the widespread use of electronic signatures are increasing. The increase in use of the authorized portal and the e-mail communication with electronic signature can also be expected. This tendency also significantly depends on the number of citizens registered in the e-SMO. The support process includes all the communication channels that were, as a part of the e-SMO project, put into service (Figure No.1).

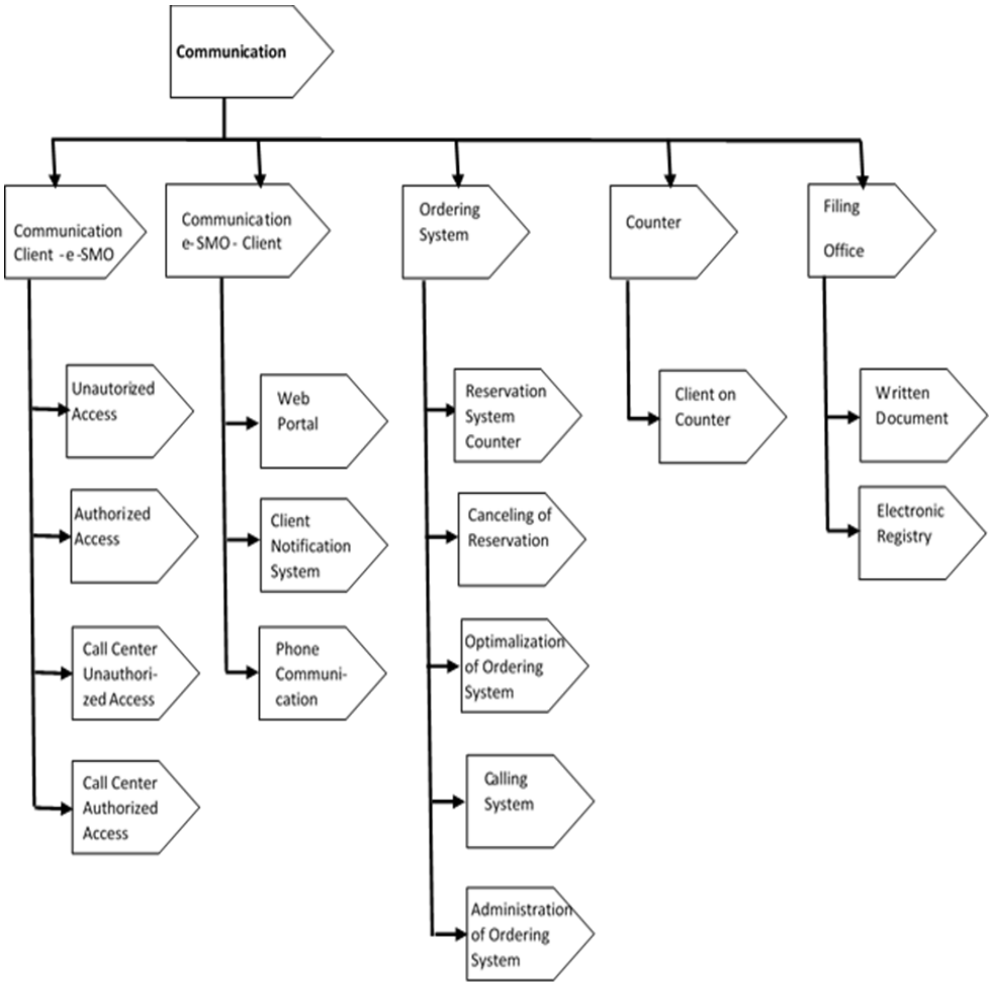

Figure 1 Schema: Description of Communication (Source: Siemens internal materials)

The process is divided into two basic scenarios:

- communication model: client - SMO - communication channels that the client can communicate with the SMO
- communication model: SMO - client - communication channels that the SMO can use for communication with clients
- and it is divided into three supporting sub-processes:
- Ordering System
- Serving Clients at Counter
- Filing Office (Vlček, 2009).

The process begins with the client's request, respectively SMO's request, to communicate with SMO, respectively to communicate with the client, and ends with establishing communication on the particular communication platform, including the client possible authorization in the e-SMO. The factual solution of the specific requirement is always part of the particular agenda.

4 Structure of ICM and IVR Scripts

Depending on the dialled telephone number the caller selects ICM script that controls the behaviour of IP Call Centre. Two phone numbers are used during the implementation. The first is intended for a common telephone contact and it is to be found in all the information media used for informing the public (Internet, message boards,...). The second is intended for VIP citizens (private telephone number) (Vlček, 2010).

After the selection of ICM script, based on the dialled phone number (DN), the verification, whether the call comes during the contact centre working hours, is done. The comparison is performed towards predefined values that are set in the configuration parameters of the utilized components. This is a static definition. So if something changes, it is necessary to make this change in configuration parameters of this object as well.

It is assumed that the IPCC occupancy is not too high. Thus, the call can be forwarded. Then there is started the main IVR script, the task of which to obtain information from the citizen needed for further decisions in the ICM script. The ID agenda and the Customer ID belong among the acquired information. These values are further used in decision-making and choosing skill groups. If there is an available agent in one of skill groups, in which the agents are grouped according to the level of knowledge, the call will be directly forwarded to the available agent. Of course, the aim is to choose an agent from the group with the highest level of knowledge at first, when there is no agent available in this group, the next group of agents with lower level of knowledge is sought through. However, if no available agent is found in any of the groups, the call is forwarded to the call queue. Based on the DN, the priority is set for VIP calls to ensure that high-priority calls will be preferred before other calls.

When the call is forwarded to the queue, the estimated waiting time is calculated. This value is then passed to the IVR script, which ensures that the caller is given a message that informs him/her about the estimated waiting time

in the queue. If the agent is available or has just been released, the incoming call is forwarded to the available agent.

Citizen communication is from technical standpoint created with E-SMO, that there is no need to change logic of functional totals if there will be an extension. Functional totals will be extended only. Changes will apply mostly extension of single menu. In the next parts are show diagrams of two situations, which may happen in communication between citizen and E-SMO.

The script will be chosen depending on dialed phone number of citizen who calling– picture number 1, which manage behaviour of IP Call centre. In implementation will be used two phone numbers. First will determine for common telephone contact and will be publicated in all informative agendes destined for well-informed citizen (Internet), Second one is to determine just for selected persons (nonpublic information of telephone number).

5 Discussions

The process management in public administration using the PAPRIS methodology on the specific case study of the statutory city of Ostrava was found to be very useful and up-to-date subject matter. The reason for the usefulness and topicality gives the increasing implementation opportunity of public and regional information systems that solve the need for public information and thanks to their content and the access are socially beneficial. The original scope of work provides the basis for further research of procedural approach for project management in development of both the public and regional administration information systems.

The examples of possible follow-up studies include further development of the procedural approach for the PAPRIS methodology based on the implementation experience in already realized IS municipal projects in the fields of development processes, supporting sources and the development of new standards in relation to new occupations created to ensure the IS project management. The study on workplace process development of the PAPRIS methodology would be appropriate. It would include organizational, technical and personnel support of the institute with the task to ensure the development of the methodology.

There would undoubtedly be requirement for the development of technical support of tools for

the process methodology support analysing the selection and purchase of tools and specification of the work procedures in the particular environment (based on the generalization gained in the course of the e-SMO project realization using the PAPRIS methodology).

6 Conclusion

The sensitive social bond, client (citizen) – public administration, may be intentionally influenced by the use of information systems and technologies. The appropriate implementation of the principles of process analysis using the PAPRIS methodology provides the opportunity to integrate automated principles into processes performed by state and local government administration.

The presented work is based on both theoretical studies of the procedural PAPRIS methodology and also on the e-SMO project implementation. Based on the specific example, the application then confirms that information and processes, respectively functioning mechanism that collects, creates, develops and produces valid and relevant information to the procedural approach, process maps and process flows, are the basic precondition for rational and efficient management of the new IS.

On the one hand, this article tries to prove the introduced fact; on the other hand it also tries to clarify the ideological concepts gained in the course of the implementation of project process technologies and methodologies in the management of information systems in public administration, and to show the specific creation and management procedure. The authors believe that the text will contribute not only to the development of theoretical knowledge, but it will also lead to the practical application of the PAPRIS methodology.

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INFORMATION SECURITY

Biometric Employee Identification System Implementation at Ardagh Metal Packaging

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Abstract. The article addresses the issue of attendance system implementation for employee identification at Ardagh Metal Packaging Czech Republic s.r.o. using biometric terminals for fingerprinting. The article describes the attendance system implementation project and problems that arose in the course of implementation. Out of 144 employees of the company, 8 did not succeed in saving their fingerprints in the database. In the article we describe the setting of S900 fingerprint reader parameters – reader sensitivity and sensitivity threshold for match identification aimed at minimizing the number of rejected authorized user registrations.

Keywords: biometrics, attendance system, attendance terminal, authentication, fingerprint

JEL Classification: D8

1 Introduction

Ardagh Metal Packaging engages in the manufacture and sale of fine metal packaging containers for food and technical filling, and is a member of the holding company, Ardagh Group – global leader in fine metal and glass containers.

The company used an attendance system with a terminal for identification media. This system no longer satisfied current requirements for smooth operation and security (Pitner and Ministr, 2015). The terminal read the information from touch identification media that suffered from faults and became worn out by long-term use. The read head of the terminal became worn along with the medium. The terminal used was equipped with the RS232 serial interface and could not be connected to the computer network. With the growing problems with employee identification, the company management decided to replace the attendance terminal with a newer one.

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In this article we describe the new attendance system solution based on the use of biometric employee identification.

2 Reasons for transfer to biometry

The attendance system supplier (Advent s.r.o.) offered some variants of the new attendance terminal solution. Following initial analysis and having considered all pros and cons, the company management opted to purchase an attendance terminal with biometric identification, specifically fingerprint identification.

The decision to replace the existing attendance terminal and purchase the biometric terminal with fingerprint reader was made by the company management mainly for the following reasons:

- Effort to eliminate identification frauds;
- Some employees used "buddy punching" for clock-ins and clock-outs. There were also reported cases of workers who had their shift marked as worked but demonstrably were not at work at all;
- Loss of identification media;
- Prestige – Be the first company within Ardagh in Europe to use such method of attendance management.

3 Biometric terminal deployment project

Biometric attendance terminal implementation consisted in the following steps:

- Setting up terminal parameters including proper synchronizing;
- Implementation in the attendance system database;
- Entering new tables, necessary for terminal-collected data synchronization, in the database.

At first, some employees were reluctant to provide their fingerprints, referring to the law on personal data protection. The supplier envisaged this alternative, though, and provided legal documents, which ultimately ensured that all employees provided their fingerprints.

There are several technical fingerprinting solutions – optical, optoelectronic, capacitive, thermal and finger-pressure scanners are available (Rak, 2008).

The S900 attendance terminal was used in the project at Ardagh. This is a terminal with password, fingerprint or ID card identification options. It has a 3.5-inch TFT display and the fingerprint reader employs the Lumidigm technology (Technologie Lumidigm, 2016). This technology works on the principle of multispectral imaging, and is able to scan and process finger features even under the skin surface. In this technology, the fingerprinting sensor consists of two main parts: the light source and the imaging system. The scanning system uses multiple lighting systems with different wavelengths, the light then passes under the skin surface, and the sensor is able to record and collect multiple identification data from the finger.

Figure 1 The S900 attendance terminal (Confis, 2016)

This terminal is manufactured by Confis s.r.o., and distributed by Advent Ltd., who uses their own Windows CE-based firmware solution (Confis, 2016).

The Czech legislation does not allow commercial entities to store biometric data (fingerprints) in their graphic form; the law allows this only to the Police and law enforcement authorities. Therefore, the fingerprint taken is converted into a binary chain, which is saved in the database. The graphic form of fingerprint cannot be retrieved from the saved chain any more. The process of fingerprint image conversion to the binary chain and fingerprint evaluation is handled by the ZKFinger algorithm in the hardware used for the project at Ardagh. The S900 reader uses ZKFinger SDK version 4.0. It is an open solution, which is fully available to programmers, software producers and system integrators. When the ZKFinger algorithm is used for fingerprint

identification, the entire identification takes place within 1 to 5 seconds depending on fingerprint quality and the quality of the chain saved in the database.

When the employee database was created, fingerprints had to be taken from all employees. The ZK4500 reader (Figure 2) was used for fingerprinting. Where possible, three fingers were read from all 144 employees, in principle both thumbs and the right index finger.

Figure 2 ZK4500 reader – optical sensor with 500 dpi resolution, sensing area 15 x 18 mm

The fingerprint reading for saving to the database takes place in three steps:

- The sensor takes the fingerprint and the algorithm converts it to a binary chain, which is saved to the database in the terminal;
- The sensor takes the fingerprint again, the algorithm converts it to a binary chain, which is compared with the previously created chain – if a match is found, the next step is taken;
- The sensor takes the fingerprint again, the algorithm converts it to a binary chain, this chain is compared with the chain in the database, the chain is refined based on specifically set criteria and saved in place of the original chain.

The third step is repeated until the result reaches sufficient quality. In the overwhelming majority of cases, the first three steps are sufficient to create a high-quality fingerprint pattern, and users do not have any problems with identification.

Out of 144 company employees, a total of eight employees did not pass through the fingerprint creation process. It was not possible to take their fingerprints in the quality sufficient for successful binary chain comparison.

An employee with a mild form of skin disorder called ichthyosis (Pinková, 2016) can be given as an example. This disorder results in a lack of identification points in the employee's fingerprints (Figure 3). The extent of the disorder is such that this employee obtained an exemption for his passport application, which was eventually issued without the obligatory biometric data.

The problem of unsuccessful identification of the other employees was caused by the physical condition of fingers. These were manufacturing workers (Figures 4 and 5).

Figure 3 Fingers of the employee with a mild form of ichthyosis

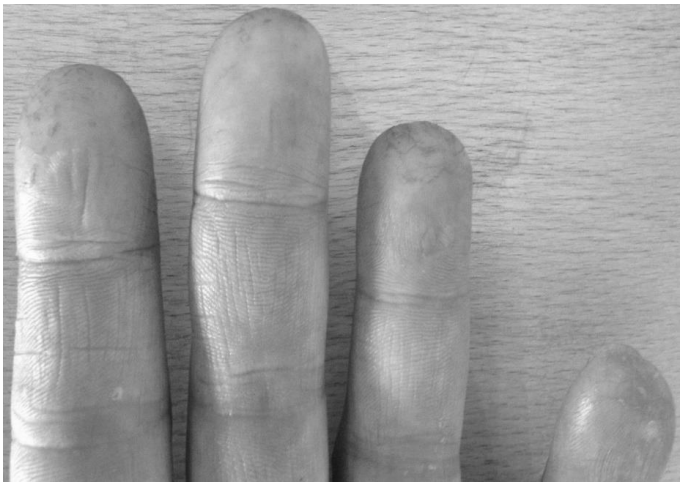

Figure 4 Fingers of the manufacturing worker – fitter

Figure 5 Maintenance worker's thumb

These employees then received an ID card and were not involved in further research.

4 First tests

When the initial setting of attendance terminal was used, identification of twenty five out of hundred employees was not successful – the terminal therefore showed 25% identification error rate. Queues formed at the terminal during the first system tests, people were nervous and impatient, which resulted in an even higher error percentage.

To ensure smooth running of things with the given number of company employees, the terminal must be able to attend at least 80 people within a time interval of ten minutes. The time for one employee identification should not exceed 5 seconds. With longer times, employees complain of identification problems (including complaints of having missed their bus due to the lengthy identification).

The terminal manufacturer states that the potential error of rejected registrations is about 1%, which was not achieved in practice even in white-collar workers who do not do manual work. The result is even worse in manufacturing workers, and the worst identification results occurred in maintenance and tool-shop centre workers. Despite all efforts, the rejected registration rate did not drop under 10 %.

5 Adjusting the attendance system reader parameters

The overall outcome of fingerprint reading and evaluation quality depends mainly on the following aspects:

- Fingerprinting
- Terminal firmware and firmware sensitivity setting
- Sensitivity threshold setting for chain match identification

These three parameters affect the overall result and error rate most.

5.1 Fingerprinting

The worker puts their finger on the reader, the reader recognizes their fingerprint, the algorithm compares the chains, and if a match is found, identification was successful. The terminal identifies the worker and shows their name. If the reader does not recognize the worker's fingerprint, the "poor fingerprint quality" error message appears. In that case, the worker has to repeat the process until the reader recognizes them.

5.2 Reader firmware and sensitivity

The S900 terminal firmware was created by Advent s.r.o. In the default setting, the reader sensitivity parameter was set to 60 % (the possible setting range is 1 to 100 %). With 60 %, however, the terminal rejected to identify almost 25 % people (see the first tests). With increasing this parameter, better and better results were achieved, but only to a certain value, when the terminal started to identify a fingerprint without touching it with a finger. This was caused by the previous worker who left his fingerprint image on the reader (probably due to finger grease). With the high sensitivity, the scanner also became more sensitive to the ambient light. The scanner falsely identified entry at regular intervals, beeped every 8 seconds, and displayed the "unknown person" message.

To solve the light sensitivity problem, a screen was fixed on the scanner, but this adjustment helped only partially. Based on scanner test results, the sensitivity was gradually decreased until it finally settled at 74%. This value guaranteed the best possible terminal function achieved by adjusting its sensitivity.

5.3 Sensitivity threshold setting for match identification

The third parameter having a significant effect on reader operation quality is its sensitivity threshold. This value ranges from 0 to 100% and determines the probability with which the just created chain matches the one that is already saved in the database.

The aim was to find a sensitivity threshold that ensures the least possible number of authorized user registration rejections, at the same time avoiding confusion of a registered person for someone else by the identification process. The default value of this parameter set by the supplier was 55 %. The threshold of sensitivity was gradually decreased, and the number of rejected identification requests was monitored.

The false rejection rate (FRR) lowers with the decreasing threshold of sensitivity. However, this value cannot be decreased indefinitely; the more it decreases, the greater the probability that the algorithm identifies a wrong person. The supplier technical support staff's experience shows that the scanner works best at values between 30 % and 35 %.

At the beginning, a total of 140 employees took part in the data collection (Table 1). With the sensitivity threshold set to 55 %, the rejection rate was over 25%. Temporary workers and fitters had a significantly higher rejection rate than the other centres.

Table 1 Data evaluation with 55 % sensitivity threshold.

Centre Name	**No. of Centre Staff**	**No. of Identification Attempts / No. of Rejections**		**Rejection Rate / FRR**	
Manufacturing	65	766	168	21.93 %	0.22
White Collars	24	246	49	19.92 %	0.20
Fitters	12	132	52	39.39 %	0.39
Tool-Shop	18	198	53	26.77 %	0.27
Electrical Maintenance	3	41	12	29.27 %	0.29
Quality	3	34	9	26.47 %	0.26
Temporary Workers	8	84	31	36.90 %	0.37
Shipping	7	72	21	29.17 %	0.29
Total	140	1573	395	25.11 %	0.25

Table 2 Data evaluation with 35 % sensitivity threshold.

Centre Name	No. of Centre Staff	No. of Identification Attempts / No. of Rejections		Rejection Rate / FRR	
Manufacturing	66	692	45	6.50 %	0.07
White Collars	24	248	8	3.23 %	0.03
Fitters	12	127	8	6.30 %	0.06
Tool-Shop	18	186	17	9.14 %	0.09
Electrical Maintenance	3	37	3	8.11 %	0.08
Quality	3	35	3	8.57 %	0.09
Temporary Workers	9	99	8	8.08 %	0.08
Shipping	7	81	4	4.94 %	0.05
Total	142	1505	96	6.38 %	0.06

It is clear from the measurement in table 2 with a sensitivity threshold of 35 % that we are under the difference threshold. The overall rate of identification rejections dropped by more than 6 %, and such decrease is not realistically possible. It means that due to wrong identification, a person is sometimes not rejected but confused for another one. Now the sensitivity percentage has to be increased to avoid mistaken identification of persons.

Table 3 Data evaluation with 38 % sensitivity threshold.

Centre Name	No. of Centre Staff	No. of Identification Attempts / No. of Rejections		Rejection Rate / FRR	
Manufacturing	68	835	82	9.82 %	0.10
White Collars	24	256	10	3.91 %	0.04
Fitters	12	152	21	13.82 %	0.14
Tool-Shop	18	229	26	11.35 %	0.11
Electrical Maintenance	3	38	4	10.53 %	0.11
Quality	3	41	5	12.20 %	0.12
Temporary Workers	12	136	23	16.91 %	0.17
Shipping	8	92	11	11.96 %	0.12
Total	148	1779	182	10.23 %	0.10

Based on measurements, the threshold of sensitivity was set to 38 %. Table 3 shows that the rejected registration rate increased.

Despite all efforts there are still many people who have smaller or larger problems with identification. These problems are not caused by the scanner settings but by the technique of touching the reader with the finger. The correct technique of touching the reader with the finger should be trained for some time to ensure as fast identification as possible. Knowing the correct procedure and the long training are the most important things for a good result. This is confirmed by the poor results in temporary workers who did not have the chance to undergo a longer training.

Furthermore it is to point out that the fingerprinting technology is also sensitive to sensor cleanliness. The sensor should be cleaned at least once per week; otherwise the identification success rate goes down.

6 Conclusion

Although 100% success rate of employee identification using fingerprints was not achieved, biometric attendance system implementation brought considerable benefits to Ardagh. The problems with false identification known from the previous attendance system were eliminated, which, among other things, resulted in a sharp reduction in overtime hours of some employees. There is no need to take care of identification media: their storage, registration, lost or destroyed media.

Biometric identification using fingerprint evaluation can be definitely recommended but one should be aware of the fact that another method of identification should also be possible. Despite all efforts, fingerprints of eight people out of 144 (5.6 %) could not be taken at all and saved to the database, and these people are identified using their ID card even after the new system implementation. According to Straus (2005), about 5 % of population is unable to provide their fingerprints so that they can be used for identification, which corresponds to the situation at Ardagh. Therefore, if anyone considers purchasing the fingerprinting technology for any application, they should take this fact into account in advance, and include it in the decision making process.

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Information Systems in Economic Security Management

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Abstract. The implementation of information systems in economic security management of Ukraine's banking sector can significantly improve the stability and efficiency of banks due to more complete use of the chances and reducing the risk of losses. This article focuses on a systematic approach to the design and selection of components of an integrated information system for the management of economic security in banking sector.

Keywords: economic security management, systems approach, information systems, software tools, banking sector.

JEL Classification: M15, D81, G21, G32

1 Introduction

Sharpening of the socio-political situation and crisis phenomena in the Ukrainian economy are threatening the economic security of the state, especially its banking sector. Risks of functioning of the banking sector are often significantly higher than in other areas. This is its specificity. Such risks can have critical consequences for the economic security of business entities of all levels. The National Bank of Ukraine Governor Valeria Gontareva (2016) estimated "the potential losses of Bank customers, which were withdrawn from the market at 111 billion UAH. Of them, 52 billion are the deposits of economic entities". All this adversely influence on the way out of the systemic crisis of Ukraine's economy, threatens the national security and requires the formation of an effective system risk-based management of economic security of the banking sector on the basis of a systematic approach with using the latest information technology.

It should be noted that the term "економічна безпека (economic security)" in the legislation of Ukraine (Verkhovna Rada of Ukraine, official web portal) and appropriate concept of "economic security" in EU legislation (Inter-Active Terminology for Europe, EUR-Lex) are not defined, although it

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is used in separate documents and in appellations of the governing bodies. Ocepek (2010) notes that each country has its own approach to the concept of "economic security." It is associated "with features of its history, geographical location and perception features of the external world".

Conceptual foundations in the sphere of National Security of Ukraine contained in the Law of Ukraine "On the Fundamentals of National Security of Ukraine" (2003). One of the main directions of public policy on issues of the National Security of Ukraine in the economic sphere is "providing conditions for sustainable economic growth by environmentally not exhausting method and increasing of competitiveness of the national economy".

In our opinion, "providing of the conditions" means the formation of new and support of existing opportunities (chances) and protection against threats (hazards) within the necessary and sufficient to implement intended goals of the Government in the economic policies according to the principles of sustainable economic development. Thus, we consider the dual nature of risk that is associated with the uncertainty of the effect of management decisions in economic security. This risk combines two main concepts: "the favorable conditions (chance)" and "the hazard (risk of losses)". The difference between "hazardous" and "favorable" situations depends on the economic agent goals and the relationships of stakeholders to the current situation.

2 Systems approach to the economic security management of the banking sector

When using a systems approach the economic security of the banking sector is considered as an important integral component of the multi-sphere and multi-level system of national security of Ukraine. National security management in the economic sector (economic security) under specific external and internal situation of the country's occurs in accordance with the goals and policies of the Strategy of national security of Ukraine (President of Ukraine, Decree, 26 May 2015) and of the Strategy for Sustainable Development "Ukraine – 2020" (President of Ukraine, Decree, 12 Jan 2015).

Economic security management system proposed considered as a cybernetic system. This system consists of the managing and managed subsystems with an open (without feedback) and closed (with feed back) control loops (see Fig. 1).

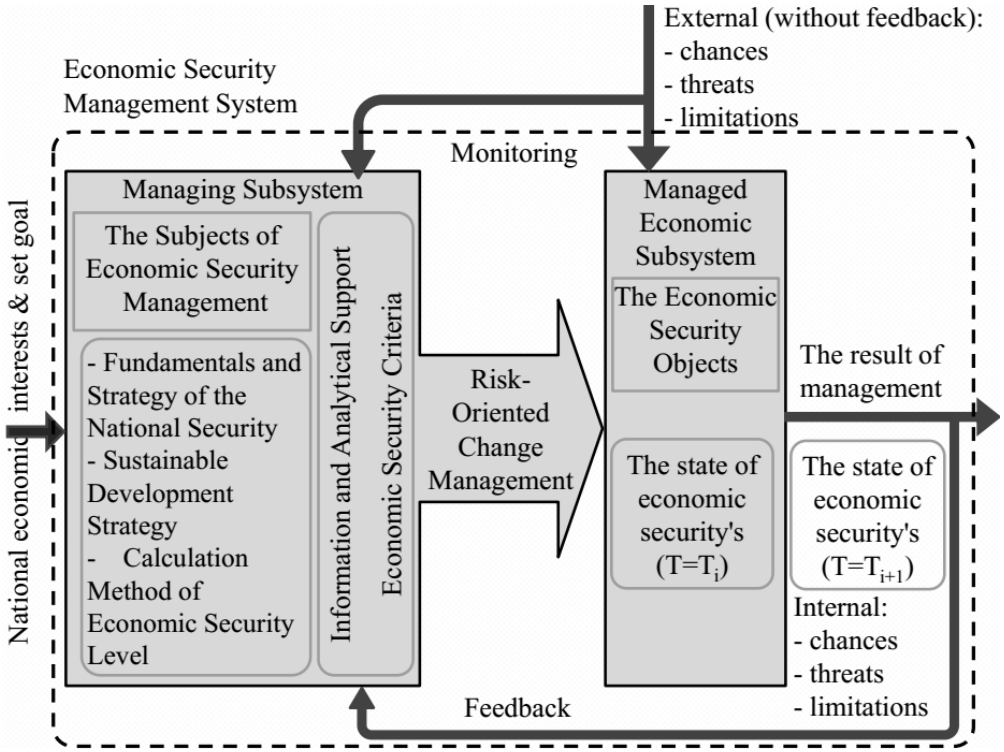

Figure 1 Economic Security Management System, Source: own.

Managing subsystem:

- defines the method of calculating target values and criteria of the economic safety of controlled subsystem;
- performs a continuous monitoring of the state of economic security according to certain criteria, and monitoring of external and internal chances, threats and existing limitations in relation to the management arrangements;
- provides continuous situational analysis and forecasting with the aim of making proactive decisions;
- performs risk-oriented change management to ensure the target values of criteria of economic security of the managed subsystem;
- performs continuous audit of the economic security management processes.

Note, that in the process of functioning of economic security management system (ESMS) must dynamically be formed (corrected, clarified) the objective function and its optimality criterion.

When choosing a decision is often present and the uncertainty of the goals. Decision-making occurs not only under uncertainty but also creates it. In this case the principle of uncertainty in ESMS will be realized cyclically as in a system which self-developing and self-improving (see Fig. 2).

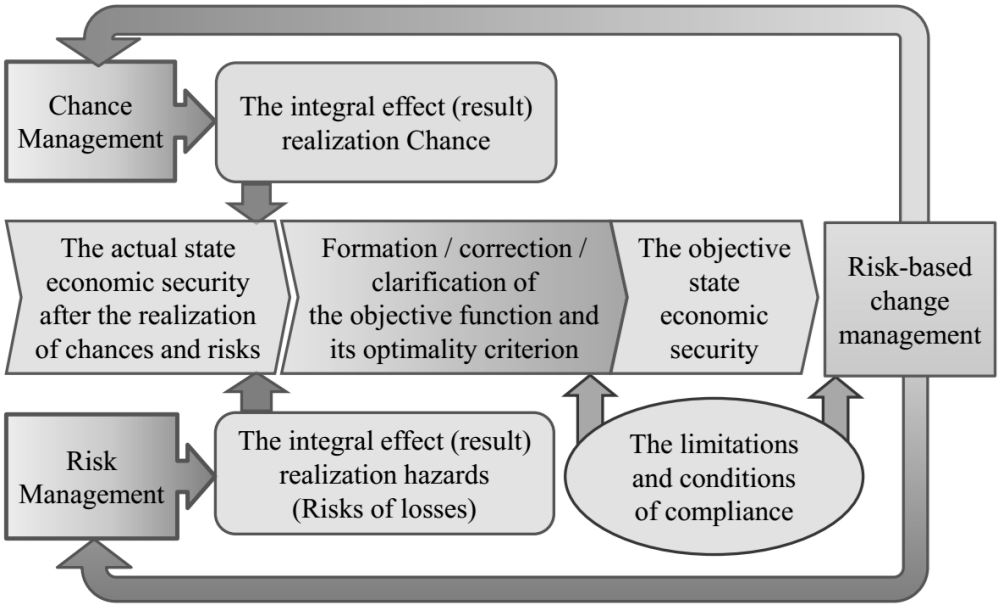

Figure 2 Cyclical realization of the principle of uncertainty in the economic security management system, Source: own.

The subjects of economic security management must to make a multi-criteria and multi-factor decisions in the presence of many limitations and in real time. Support of these decisions is possible only on the basis of wide use of advanced information technologies and creation of a unified information space in the state (Pitner and Ministr, 2015).

3 Information technologies in the economic security management systems

The use of technology of expert-analytical situational centers (EASC) is promising to ensure a continuous process of information-analytical support real-time management decisions for economic security (Ilin N.I., Demidov N.N. and Novikova E.V., 2011). Currently "by the decision of the National Security and Defense Council of Ukraine (NSDC), the NSDC Military Cabinet and the Main Situational Center of Ukraine were created, the network of situational centers of the defense and security sector bodies, central and local executive authorities is actively developing" (Turchynov, 2016). An important component of such network situational centers for economic security management, in our opinion, should be the hierarchical system EASC of proactive response that will work the same for all network interactions regulations.

For the system EASC are proposed a four-tier architecture that meets the strategic, tactical, operational and situational levels of economic security management. This hierarchical system combines methodological and expert resources, software and hardware tools information and analytical support effective decision-making under uncertainty. The structure of the system EASC includes the Main expert-analytical situational centers (macro-level), Sectoral and Regional (meso-level) situational centers, Local (micro-level) situational centers and Personal portable situational centers for the decision makers at the nano-level (see Fig. 2). Such a network of EASCs makes it possible to ensure coordination and control of the actions of the subjects of economic security management concerning the prevention and localization of emergency situations in real-time.

For subsystems of information and analytical support EASC are proposed to use such technology as: Decision Support System (DSS), Expert System (ES), Geographic Information Systems (GIS), Fuzzy Neural System (FNS), Automated Systems of Expert Estimation (ASEE), Business Intelligence and Advanced Analytics (BI&AA), Big Data (BD) and other.

In the system of economic security management are proposed to use the GRC (Governance, Risk and Compliance) Technology to automate continuous

monitoring, auditing and risk-chance management in the presence of limitations.

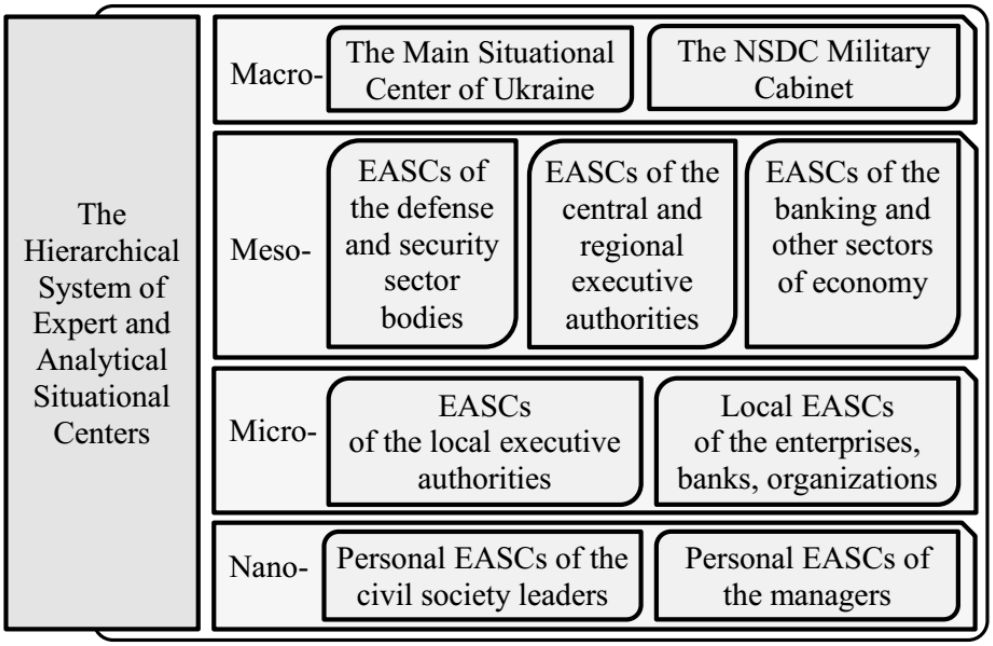

Figure 3 The Hierarchical System of Expert and Analytical Situational Centers. Source: own based on (Law of Ukraine, 2003).

Additionally can be used a specialized risk management system, for example, Operational Risk Management System.

4 Software Tools for the Economic Security Management Systems

Currently there are no ready-made information and communication systems for the economic security management at different levels (macro, meso, micro, nano). Therefore, the necessary system integration of individual specialized it solutions from leading companies to further its application in the management of economic security. To select the best solutions on the market we can use the results of research well-known companies that are published regularly, for example, Gartner "Magic Quadrant" (http://www.gartner.com) or "Chartis RiskTech100" of the company Chartis (http://www.chartis-research.com) and others. So, in February 2016, Gartner has published the results of market research IT platforms for Business Intelligence & Analytics (Parenteau et al,

2016), as well as for Advanced Analytics (Kart et al, 2016), which is shown in Fig. 4 and 5.

Figure 4 Magic Quadrant for Business Intelligence and Analytics Platforms, Source: Parenteau et al, 2016.

In this research vendors are assessed for their support of five main use cases: Agile Centralized BI Provisioning; Decentralized Analytics; Governed Data Discovery; Embedded BI; Extranet Deployment.

Figure 5 Magic Quadrant for Advanced Analytics Platforms, Source: Kart et al, 2016.

This report includes vendors that, in addition to traditional business intelligence functionality querying and reporting, offer integrated methods for data analysis. The analysis of the reports shows that the sum of the occupied seats in the markets BI & Analytics Platforms and Advanced Analytics Platforms are leading such companies as SAS, SAP, Alterux. Companies SAS and SAP also held a high place in the Magic Quadrant for Governance, Risk and Compliance technologies (Wheeler, 2015). Consequently, the IT solutions of these companies in the first place can to consider for use in the economic security management systems.

5 Conclusion

The economic security of the banking sector is considered as an important integral component of the system of national security. The management of economic security should be considered as a cybernetic system and to take into account the dual nature of risk: risk as the chance and risk as the hazard. It is shown that in the process of functioning of economic security management system must be cyclically formed the objective function and its optimality criterion.

In the economic security management system proposed used technology of expert-analytical situational centers and GRC technology to support real-time decisions and automate continuous monitoring, auditing and risk management in the presence of limitations. The proposed use of the results of market research it solutions from leading companies allow to select the necessary software tools for the system of economic security management.

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Dynamic Identification of Devices in Cyberspace

Elena Nyemkova[1], Zenoviy Shandra[2]

Abstract. The article is devoted to experimental studies of the noise for dynamic identification of electronic devices. The simulation of phase trajectory was carried. Analysis of the noise temporal characteristics confirms their fractal nature. Parameters of phase portraits of spectral noise components give the chance the electronic devices authentication. Oscillator model makes it possible to estimate the parameters of phase portraits.
Experimental studies have shown that there is the effect of the formation of temporary structures in the behavior of the noise spectrum. The number of temporary structures is not dependent on the number of spectral components.

Keywords: identification in cyberspace; authentication of electronic devices; phase portrait of noise; strange attractor; limit cycle.

JEL Classification: C61

1 Introduction and purpose

Modern computer systems and networks are exposed to thousands of different attacks, both outside and inside. A significant part of the attacks is due to an access violation when the attacker becomes a legitimate user. This is made possible by weak authentication attributes of legal entity. Biometrics techniques were developed for the admission of people. For electronic devices also need to develop similar techniques that would make it possible to uniquely identify a particular device in a critical facility management system, the Internet of Things, telemedicine, etc. The problem of electronic devices authentication must be solved for network interaction of cyber physical systems elements (Kupriyanovsky, Namiot and Sinyagov, 2016). For example, the authentication problem of devices for accumulation and processing of acoustic information are caused by the use of acoustic diagnostics of devices of machines, pipelines, as well as in telemedicine. Authentication of mobile phones is often necessary to solve the forensic matters (Hasse, Gloe, and Beck, 2013). The example of development of Toshiba's products indicates that the

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interest in the authentication of electronic devices has evolved from a purely theoretical to practical (Toshiba, 2015).

The challenge is to develop methods of recognition, which would provide unambiguous information on the specific unique device. Clearly it would be most appropriate device to identify signals that are unique to this device. Many researchers have come to the conclusion that such information may be inherent noise signals.

Any electronic device consists of a set of elements that are different in the parameters within limit variations. Nobody can make exactly the same elements at the micro-level, so that these differences are manifested in deviations of parameters at the macro level of devices: linear gain tract characteristics, resonant frequencies, noise ratio and others.

The authentication process of the electronic device is determined by measuring a parameter. Thus, in the above example, the development company Toshiba impulse noise is used to identify the chip by implementing physical unclonable function. Authentication accuracy is determined by quality measure which depends on the technical equipment, measurement methodology and the selected identifier. Therefore, comprehensive approach is needed to meet the challenges of authentication of electronic devices.

Two addresses of electronic device are used to identify in the network - the physical (MAC) and the logical (IP). These addresses are fairly easy to change, particularly the logical address, which until recently was needed for sending data packets only. Simplicity changing of network devices addresses requires new methods of strong authentication, which is performed for a particular device and which cannot be given to him from the outside. This possibility is due to the difference of electronic devices at the microscopic level, which can only be manifested on the device noise level.

Electronic device noise in the first approximation can be regarded as white noise. Individuality of noise for each electronic device is manifested to differences from the white noise model. The article deals with the noise of the electronic device as a computer audio card.

The purpose of this study is to show the possibility of using of the natural noise of electronic devices for problems the identification and authentication of devices in cyberspace. This requires choosing the noise parameter which

does not depend on a particular time series, but only from the physical characteristics of the electronic device.

2 Experimental research of the noise characteristics

Many researchers believe that the noise contains information about the features of the physical realization of the recording devices. Appropriate noise data processing can uniquely point to a particular device. Multifractal approach was applied for microphone identification (Zhuravel, Rybalsky and Solovyev, 2013), wavelet analysis has been used to identify these features. Statistical characteristics of the recording equipment has been identified from the files that were been investigated. This was done by to compare the statistical characteristics of the audio files which have been recorded on various recording equipment. For further analysis the noise was isolated from the particular sound file. It was shown experimentally that the statistical characteristics of the noise were significantly dependent on the recording equipment settings. No monotonic behavior of static characteristics of the ADC (analog-to-digital converter) can be considered as the authentication parameter recording equipment. Fractal analysis was used to determine separation criterion of data in this case.

Identification of digital audio devices can be based on the analysis of digital images, which are formed using those (Chumachenko et al., 2007). Spectrograms of the signal can determine deviations that are characteristic for a particular audio recording device. In fact, spectrum analysis is performed. Signal processing algorithm may also be an identifying attribute, such as defining a set of stationary components and their harmonics that are present in the signal. For this the Gabor transform was used in unlike the Fourier transform. This approach is, valid for the voice signal, which changes only slightly in the range of 10-20 msec. Therefore, it can be divided into separate sections and carry out frequency analysis.

Preliminary analysis of the noise amplitude of the audio card gives reason to assume that the noise is a random signal. The behavioral analysis of Hurst coefficient was used for searching of characteristic noise parameters (Chaplyha, Nyemkova and Shandra, 2015). Dynamics of Hurst coefficient was calculated for the different spectral components of the noise. In the experiment with followed by treatment important features were recorded for noise audio

card. Firstly, the spectral noise components have multi fractal dimension, which is time-dependent. Fractal dimension of each spectral components of the noise does not change in phase. Secondly, it is shown that the Hurst coefficient values essentially depend on the initial point of noise time series. Therefore, at this stage understanding coefficient Hurst its use for authentication purposes is not possible. However, the study of fractal dimensions of spectral noise component audio card made it possible to assert, that for a given electronic device spontaneous formation of temporary structures is observed. Each structure is characterized by a limit cycle (Chaplyha, Nyemkova and Shandra, 2016).

Experimental study noise of audio card was performed by the modeling its behavior. The noise of audio card was researched via Oscillometer program. The sampling frequency was equal to 44.1 kHz. Minimum frequency in the Fourier transform and the distance between adjacent spectral components was set using the window length. Shift between adjacent windows was equal 1/44100 sec. The amplitude of the signal output from the audio card was measured using Oscillometer program and no signal is input to audio card, Figure 1. At the beginning of the measurements transition process was observed, that was not considered in the calculations.

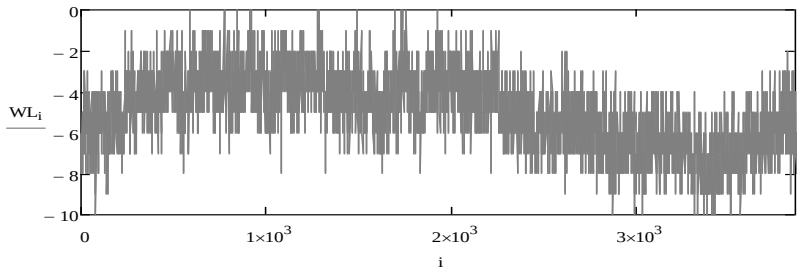
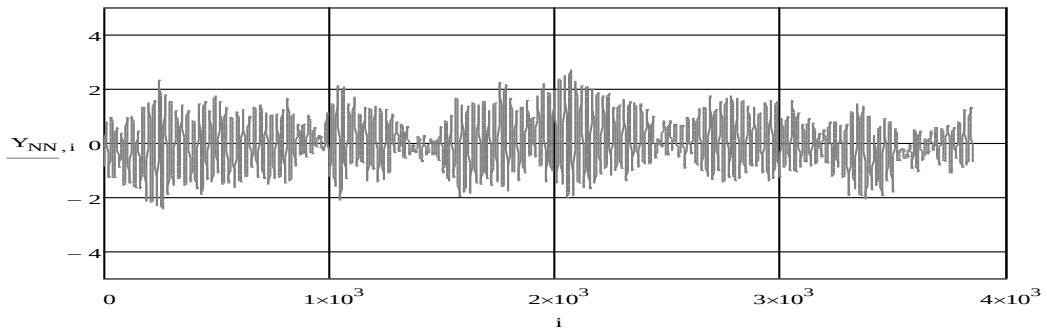


Figure 1 The time dependence of the of the noise amplitude at the output audio card. Source: own.

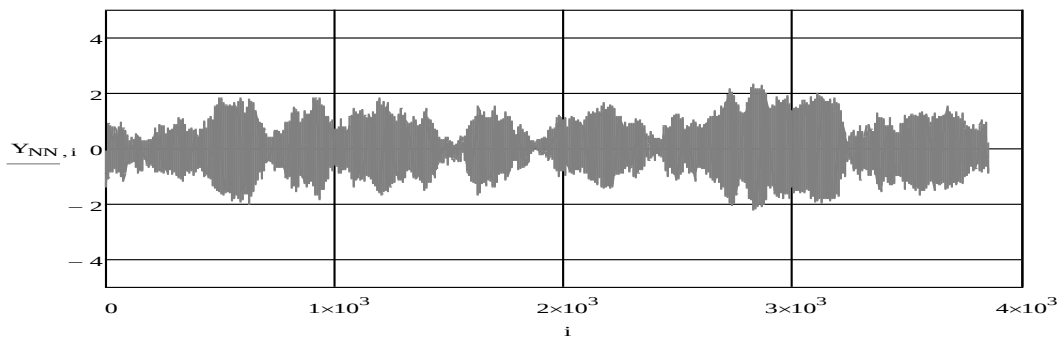
The noises of audio cards have a discrete nature as time-dependent analysis shows to a larger scaled. Audio card consists of several blocks such as input and output mixers, Analog-to-digital converter (ADC) and Digital-to-analog (DAC) converters, Processor, Synthesizer, Bus PCI and Connectors. Only the DAC, a Mixer and Connectors are involved in the formation of the noise of audio cards for our experiment. DAC and Mixer are complex electronic devices which are composed of triggers, and various resonant circuits. It is known from the radio that the complex wireless devices can form

distribution circuit with strong capacitive and inductive coupling. Triggers are bistable system, their presence in the radio circuit leads to several points of stable equilibrium. Contacts are the source of thermal noise and specific contacts noise. These elements produce noise near the resonance frequencies. Noise spectrum is limited to sampling frequency, which can be observed. Experimental studies have shown the effect of the formation of temporary structures in the behavior of the noise spectrum. The number of temporary structures is not dependent on the number of spectral components.

Dynamics of changes in the imaginary part of the Fourier components of noise series with the numbers 22 and 62 is shown in Figure 2. The dynamics of the real part of the Fourier components has a similar view.



a)



b)

Figure 2 The time dependence of the imaginary part of the Fourier components of noise series for the audio card desktop computer: a) for n=22, b) for n=62. Source: own.

Window length was 4410 samples. Fourier transform for 512 point was used. All mathematical operations were performed using Mathcad program.

Chart shows the formation of temporary structures. The repeatability of temporary structures is about 300 samples. Temporary structures are approximately the same.

Temporary structure is shown in Figure 3 on a larger scale. Type structure resembles a short-term sine process that develops, lasts for some time, and then dies.

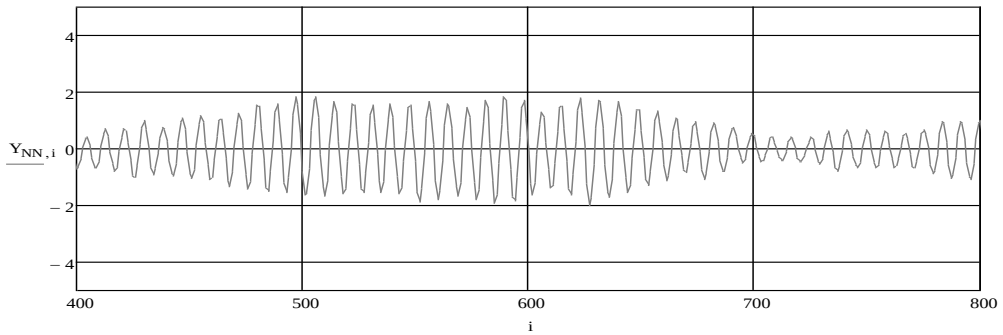


Figure 3 The imaginary component n=62 on a larger scale. Source: own.

The dynamics of the amplitude spectral component of the noise was investigated in the phase plane. The real and imaginary Fourier components lay along the x and y axes. The phase portrait of the spectral components of n = 22 and n=62 is shown in Figure 4. The hypothesis is made that the phase portraits are strange attractors.

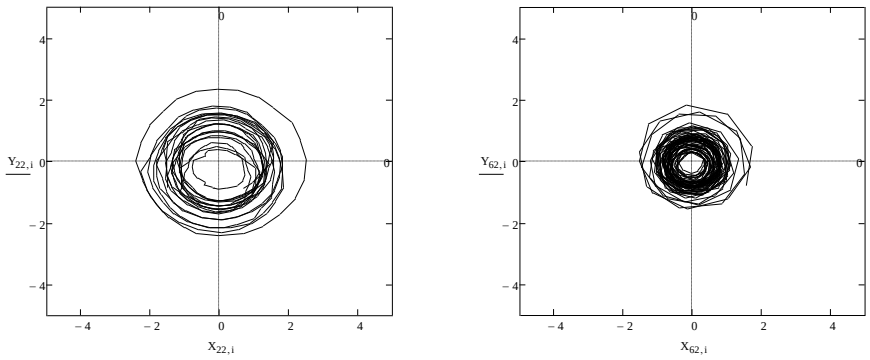


Figure 4 Phase portrait of the Fourier components for 500 samples: a) for n=22, b) for n=62. Source: own.

Phase portraits of low-frequency Fourier components were used for further analysis since more marked features of phase portraits is observed.

Analysis of phase portraits for the low-frequency Fourier components shows the following behavior: first phase portrait resembles the limit cycle - pseudo limit cycle, with time cycle goes astray and a new cycle begins. This goes on all the time. Each pseudo limit cycle is shifted with respect to the coordinate zero. The shift for each cycle there is different. Fragments of the phase portrait for the fourth Fourier component are shown in Figure 5.

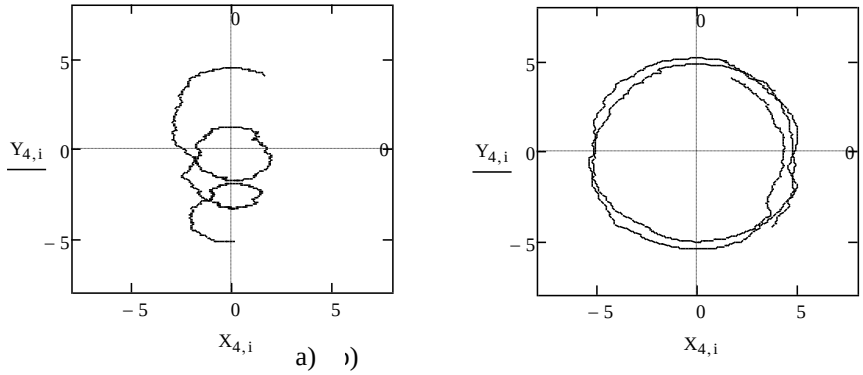


Figure 5 Formation of limit cycles for fourth Fourier component: a) samples from 1 to 400, b) samples from 400 to 800. Source: own.

Motion of phase trajectory takes place clockwise. Phase portrait occupies a limited area on the phase plane. The motion of trajectory occurs in a spiral as long as the phase portrait becomes identical to the limit cycle. Then, the phase trajectory moves in a spiral again and achieves its highest point. Further there is a downward spiral, the limit cycle is repeated. Formation of the phase portrait is completed downwards spiral.

It should be noted that for high-frequency Fourier components shifts of phase portraits are not observed visually.

3 Simulation of the phase portraits of noise

Today it has become known a growing number of relatively simple examples of spontaneous appearance of temporary structures in disordered systems (Nicolis and Prigogine, 1977). It is a testament to the self-organization processes in irreversible processes. For electronic devices the presence of self-oscillatory systems is characteristic. Spontaneous pattern formation takes place in trigger-type systems (Ebeling, 1977). A limit cycle is characterized by constant amplitude. The trajectory describes the stationary harmonic

oscillations. Nonlinear oscillator model is used in the research of noise in radio frequency integrated circuits (Mehrotra, 1999).

Let us consider the two-frequency oscillator model as

$$f(t) = sin(2\,\pi iv0/44100) + sin(2\,\pi iv1/44100) \qquad (1)$$

Frequency ν0 and ν1 are set equal to 13 Hz and 180 Hz, and call them to define the low frequency and the basic frequency. This choice of model signal frequencies is due to the following. The length of the measurement window is 0.1 seconds. The minimum frequency for the Fourier component is equal 10 Hz. The second component is located at the frequency of 20 Hz, the third - 30 Hz, and the fourth - 40 Hz. The signal is not visible in the Fourier spectrum, if the frequency is below 10 Hz. The simulation showed that the signal with frequency close to the minimum frequency of Fourier transform shift the limit cycle on the phase plane, as can be seen in Figure 6.

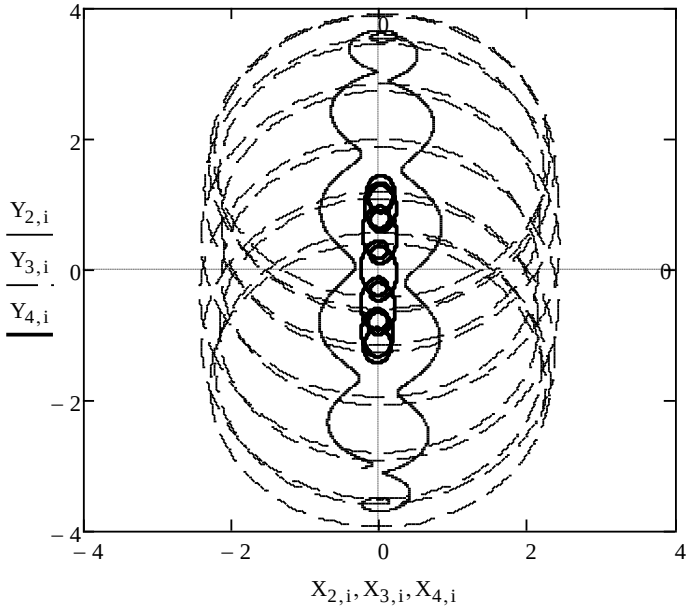


Figure 6 Phase portrait for the three Fourier components of the signal model. Thin solid line - the second component, dashed line - the third component, fat solid line - the fourth component, n=3000. Source: own.

Position of the limit cycles centers for the basic frequency is sensitive to the value of the lower frequency. Increasing the lower frequency at the 1Hz leads to shift of the phase trajectories; each of them is shifted differently.

The addition to the model of third oscillator with a high frequency explains the slight unevenness in the phase portrait or low Fourier components. Figure 7 shows fragment of phase portrait for fourth Fourier component, n=600. The simulation showed that the signal processing (discrete Fourier transform) significantly affects the outcome, even if the signal is the sum of sine waves. An important processing parameter is the length of the window, which determines the minimum frequency of the discrete spectrum. Features of the noise signal can be studied by changing processing parameters.

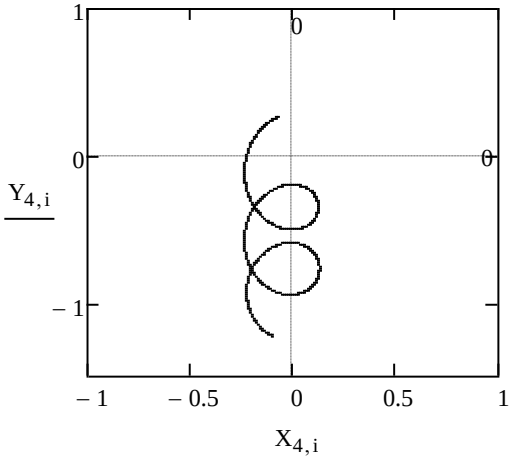


Figure 7 Fragment of Phase portrait of fourth Fourier component for the model. Source: own.

Changing the window width determines the presence of frequency that is lower or similar to the frequency of first discrete component. A study of low-frequency discrete spectrum proved more informative than its high-frequency part. Thus, the phase portraits of high-frequency component cease to feel the presence of low frequency, their center coincides the origin of coordinates. Lower frequency changing by 1 Hz results in a significant shift of the characteristic points of the phase portrait. Thus, measurement of the mutual disposition of characteristic points makes it possible to determine the lower frequency.

4 Conclusion

The emergence of temporary structures for noise of computers audio card shown experimentally. Analyses of these temporary structures are

conveniently carried out with the use of phase portraits of the spectral components. Phase portrait for low-frequency discrete component of noise is a set of limit cycles, each of which has an individual shift relative to the origin. This shift is due to the presence in the noise spectrum of low-frequency components whose frequency is lower than the frequency of the first discrete Fourier component. The proposed model of the two oscillators explains characteristics of phase portraits of the noise spectrum. Shifts of limit cycles of the real noise can serve as an authentication characteristic of the electronic devices.

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Cybersecurity Education for Information System Specialists

Tomáš Pitner[1], Jan Ministr[2]

Abstract. Cybersecurity is not a concern just for security specialists. If the information systems are not designed with security considerations and design decisions, they cannot be effectively protected when in operation. Therefore, educating future information system developers in specific parts of computer security is a crucial precondition ensuring a secure design and operation of information systems in collaboration with security specialists. We present considerations and propose a specialized study field for information system experts with focus to secure design and operation of information systems, colloquially called *Security-assured Information Systems*.

Keywords: cybersecurity, security-assured information systems, information system developers, education.

JEL Classification: C61

1 Context

In our previous paper we discussed new trends in educating IS experts for practice. Cybersecurity was one of the features a new curriculum for IS developers should contain in order to keep pace with contemporary requirements in the field. Apart of this, we explicitly mentioned software architectures tailored for today's computing architectures, namely clouds. The third

Cybersecurity is not a concern just for security specialists. If the information systems are not designed with security considerations and design decisions, they cannot be effectively protected when in operation. Therefore, educating future information system developers in specific parts of computer security is a crucial precondition ensuring a secure design and operation of information systems in collaboration with security specialists. We present considerations and propose a specialized study field for information system

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experts with focus to secure design and operation of information systems, colloquially called security-assured information systems.

2 Information systems security

In this section, we will identify areas where the traditional security requirements imposed on information systems (and thus to their developers) are now shifting in several directions requiring strengthened attention also in education of future IS experts (Ministr and Pitner, 2016). We see at least the following important areas causing different security requirements – new cloud-based development and deployment technologies, and new user-related security issues. Thus, the complexity of security requirements grows and must be properly reflected in the design of any new information system. Therefore, new techniques how to involve these requirements are needed.

2.1 Technology-related security issues

The phenomenon of cloud computing brings many advantages mainly related to efficient use of resources such as hardware and energy needed to operate the computing and storage infrastructures. Clouds also reduce the need for locally trained professionals experienced in server maintenance and datacenter operations. However, as a drawbacks, it is more dynamic and less under direct control in the sense of traditional system perimeter.

Zissis & Lekkas (2012) have identified *generic design principles of a cloud environment which stem from the necessity to control relevant vulnerabilities and threats.* They also claim that security in a cloud environment requires a systemic point of view, from which security will be constructed on trust, mitigating protection to a trusted third party. It again requires an integrated approach starting already in information system analysis and design phases.

2.2 Security requirements engineering

Recently, the whole society faces challenges related to security of infrastructures ensuring its functioning. The measures to ensure reliable and secure operation of such infrastructures are regulated by growing number and complexity of legal and governmental requirements (Racek, Dana, and Fristik, 2015). Therefore, the approaches to ensuring the security of information must be more sophisticated (Mellado, Fernández-Medina & Piattini, 2007).

The authors identified the importance of formal management and engineering of security requirements for modern information systems already in 2007. The saw a gap between the design phase where security requirements were often overseen and the later implementation, deployment, and operation phases where they had finally to be reflected which was often too late and did not allow to construct a robust information system (Motschnig et all., 2014).

Approaches to extend Requirements Engineering modelling and formal analysis methodologies to cope with Security Requirements have been a major effort in the past decade (Massaci, Prest & Zannone, 2005). In order to ensure secure design during the whole development process, there are security standards such as the Common Criteria (ISO/IEC 15408) dealing with the security requirements along all the IS development cycle.

Mellado, Fernández-Medina & Piattini (2007) proposed a standard-based process that deals with the security requirements at the early stages of software development in a systematic way based on the reuse of security requirements, by providing a *Security Resources Repository* (SRR), together with the integration of the *Common Criteria* (ISO/IEC 15408), and also the *SSE-CMM* (ISO/IEC 21827) into software lifecycle model.

3 Current studies in cybersecurity and information systems

3.1 Structure of studies

Faculty of Informatics at Masaryk University designs its study programs and fields similarly to other EU-universities according to Bologna Declaration, i.e. dividing it into consecutive 2+1 levels – 3 year Bachelor-, 2 year Master-, and 4 years PhD-degree programs. By far, the most popular setup for most students is a combination of the Bachelor and subsequent Master programs. Still not enough students are continuing with a PhD to be able to conduct research in respective fields. Majority of students still come from Czechia and Slovakia although some of the Master programs can be studied in English.

Related to preparation of future experts in information systems and computer security, the study path starts with a Bachelor-degree program. In many cases, the students either do not have preferences what they exactly want to do in the IT industry after graduation. So, they usually select Applied

Informatics or Computer Systems and Data Processing. For security experts oriented at networking, they might be interested in Computer Networks. Generally, the selection at the Bachelor level does not prevent neither limit one's options at the Master level. Together, there are 12 study fields at the Bachelor level.

At the Master degree level, the selection is even broader, offering 15 fields. For further considerations, *Security of information and communication technologies* and *Information systems* are the most relevant, so we introduce them now.

3.2 Security of information and communication technologies

This field of study focuses on areas of security in computer systems and networks, cryptography and its applications, see (Masaryk University – Information Technology Security, 2016). A graduate is expected to work in a variety of roles critical to ensure security of ICT. Profiling of individual studies (cryptography, technological aspects or security management) is left to the student (Repka, Danel and Neustupa, 2013). There are two orientations, namely *Security of ICT* (more principles and technology) and *Cyber-security* (more management and law).

The orientation *Security of information and communication technologies* is aimed to prepare the graduates to work in the area of the development and management of systems that support security, or to properly select and apply cryptographic methods to ensure specific security functions. Graduates develop, configure and maintain systems with security requirements. The orientation in taught in English or in a combination of English- and Czech-language courses.

The orientation *Cyber-security* apart of the fundamentals that are common within the study field, is focused more towards multidisciplinary aspects of cybersecurity, i.e. also outside of the classical system perimeters. It brings together technical, social, management and legal aspects of cybersecurity. Graduates are ready to work in organizations that are supposed to comply with specific cybersecurity regulations such as the Czech Cybersecurity Law. They ensure design and deployment of cyber-security processes. Due to partial specifics, only some courses are in English, majority is in Czech.

3.3 Information systems

Information systems are traditionally one of the main domains of software development and we meet with them in daily life all too often. Currently shifted increasingly towards the needs of users, the increasing attention to their ease of use, availability, mobile devices, but also the security and reliability of operation (Masaryk University – Information Systems, 2016).

This field of study is focused on the knowledge and skills needed in all stages of development, management and modification of information systems, in general, as well as other large software systems (Sutirtha Chatterjee et all., 2015). The emphasis is on skills needed in the analysis and requirements specification and system design.

Both study fields aimed at computer security an information systems have covered the needs of students and IT industry well for many years (Ministr and Pitner, 2015). However, we face new challenges related to changed conditions imposed by new technology such as mobile networking, clouds, as well as new regulations in data privacy and cybersecurity, accompanied by increased risks of massive cyberattacks, cyber-frauds, and the like. Similarly to other universities (Lersais, 2016), we also see an urgent need to provide advanced studies for information system professionals aimed at design, implementation, deployment, and management of security-assured information systems. We will now discuss the proposal in more details.

4 Security-assured Information Systems

4.1 New study program profile

The current development of information technologies, methods of their use, as well as new contexts and forms offer a completely new requirement, and the opportunities that master's specialization in Information Systems at the Faculty of Informatics, defined in its main outlines, nearly one and a half decade, in its current form does not fully reflects.

Therefore, the new program proposal pursues the following main objectives. It offers those interested in a future career of information systems developers an advanced (master) study program, which builds on the previous fundamentals of computer science and information technology and also gives an option according to their preferences to deepen the knowledge and skills

necessary for qualified profession analyst and/or implementer of information systems mastering key aspects of IS deployment and operation, as well as the manager responsible for planning, implementing and managing information systems and technologies in enterprises and other organizations. Graduates will be qualified to participate in the design, development and operation of information systems and other large software systems and manage these processes. The emphasis is on skills needed in the analysis and requirements specification and system design.

The study program newly introduces the opportunity to graduate from one of three specializations:

- *architectures and technologies*, which can handle contemporary software, networking, database technology and other business systems;
- *in software engineering*, which focuses on contemporary management methods and software development process;
- *security-assured information systems*, where attention is focused on the quality of the design of architectures developed enterprise systems and links to safety critical (information) infrastructures.

Moreover, the program is currently being prepared so that at least one cross-specialization can be completed in English.

4.2 Structure of the security-related part

All graduates have a basis in both views on security: security technology and security management. A student wishing to have a specialization in security-assured IS should gain a deeper knowledge towards thinking of "security by design", i.e. design of secure systems. There should be enrolled compulsory and obligatory-optional courses having at least 13 ECTS credits for the security-assured IS. They cover the areas of:

- In *fundamentals*: Cryptography and cryptographic protocols, applied cryptography;
- In *secure software development*: Secure coding principles and practices, System verification and assurance;
- In *secure architectures and design*: Security architectures, Secure network design;

- In advanced topics such as *critical infrastructures*, or *smart system security:* Advanced topics in IT security.

5 Conclusion

This new study specialization in security-assured information systems reflects current demand for security-aware information system professionals and according to experience already gained abroad, it tries to satisfy their present needs. In the future, its continuation in form of a multidisciplinary PhD-degree in topics of secure societies is foreseen.

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Tools for Fraud Detection in Insurance Image Data

Jaroslav Ráček[1], Josef Daňa[2]

Abstract: This article is describing a computer vision method used for detection of insurance frauds that is based on image analysis of documents attached to the insured incident case. Local descriptors are used for detecting duplicities in visual data. Described application allows for several ways of image comparison.

Keywords: Computer vision, Image data, Insurance fraud detection, Local descriptors.

JEL Classification: C6, M15

1 Introduction

Computer vision is the area of artificial intelligence that is focused on mining information from visual data. In certain way, this area can be perceived as being the opposite to the computer graphics. While computer graphics is creating visual data from information describing the object, computer vision is dealing with inversed process (Ministr and Pitner, 2015).

In research and industry, increasingly higher amount of attention is aimed on searching in image databases through computer vision. Growing computing performance with advances methods allows for imitating human eye perception of a scene (Lowe,1999). This article is presenting methods and tools used for detection of duplicities and frauds in visual documentation of insured incident cases in insurance companies.

2 Description of images using descriptors

In order for a computer to understand an analyzed scene, it is necessary to describe it using descriptors (Parker, 2010). Generally speaking, a descriptor is anything that is describing analyzed object in any way.

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These methods can be divided into two groups based on the way of description of individual images:

- Global descriptors that are describing the picture as a whole
- Local descriptors that are focused on meaningful points and their proximate neighborhood.

For purposes of images detection in insurance incidents, local descriptors are regarded as more appropriate.

3 Local descriptors

For description of an object inside an image, methods based on local descriptors are using certain key points from whose proximate neighborhood are respective descriptors being calculated. Finding these key points is the goal of "detectors" – specialized algorithms that are usually (but not conditionally) tightly connected to the description of given key points (Hua, 2007). Given that various detectors can be used in combination with various descriptors, it is good to distinguish between key point and its detector and descriptor.

The process of identification of individual key points between two pictures usually includes following steps:

1. Detection of key points.
2. Calculation of descriptors in these key points.
3. Identification, based on (e.g.) closest neighbor in descriptor space method.

An ideal detector is detecting specific key points in given area in such a way that this detection is repeatable even in situation where the angle of point of view of an observer (camera) has changed. Generally speaking, an ideal descriptor is robust against all possible transformations that may happen to given scene. Similarly, ideal description of key point is recording the most important and most determining elements of given areas so that the structure can be detected. Moreover, apart from qualities described above, the calculation of key points detection and description must be sufficiently fast so it will meet requirements of a time frame defined by the conditions of a particular task.

3.1 HOG descriptors

HOG (Histogram of Oriented Gradient) descriptors are representing a class of descriptors that are using histograms of gradients for detection of neighborhood, while individual categories are orientations of change of gradients discretized into several directions. The amount of these directions may vary depending on selected degree of granularity. Descriptors from this class usually have high robustness against transformations and achieve very good results in computer vision. A question might come at hand – why not use these descriptors in most of the cases? A significant disadvantage of these descriptors is that they are computation intensive and, therefore, might not be used in applications running in real time.

3.2 Binary descriptors

Another class of descriptors are binary descriptors that are fulfilling the requests for high speed calculations. Most of these methods are using series of relatively small amount of selected pixels' intensity comparisons. Extreme speed of these comparisons is based on binary nature of these descriptors – two binary descriptors are compared using Hamming distance that equals to the sum of XOR operations between two binary chains (one SSE instruction on most modern processors' architecture). On the other hand, fast speed of these methods have the downside of a high sensitivity to transformations between compared images (zoom, rotation, movement, etc.)

3.3 SIFT descriptors

SIFT (Scale Invariant Feature Transform) is an approach introduced by David Low in 1999. This approach includes both detection of key points and their description. SIFT transforms an image into a set of key points and their local descriptors while each of these local descriptors is invariant to various transformations. These qualities make SIFT robust enough for means of identification and makes it one of the best and most precise descriptors so far. Disadvantage of SIFT is its high computational complexity. SIFT Calculations include both detection and description of key points, it is a detector and a descriptor at the same time.

4 Tools for duplicities detection

A set of tools for detecting duplicities in insurance companies' data was developed based on above mentioned descriptors. These tools are used for detecting insurance frauds where similar images are attached to more than one incident case or when one incident is photographed more than once, so that multiple image sets are created over one case.

An incident case is usually attached with 10 – 30 images. For comparison of incident cases, the whole set of images is being compared between each other. The result is stating how many tuples of similar images from first and second set were found and what is the degree of correspondence between these tuples. An output comparing two different pictures of damage happened to the same vehicle is portrayed on Figure 1 below:

Figure 1 Similarities found in images

Currently, on regular servers that insurance companies possess, it is possible to make 10 – 200 million of picture comparisons per day. The speed of calculation is dependent not only on the particular hardware configuration, but also on amount and type of descriptors and overall amount of indexed images in the database.

There are 3 basic scenarios available for image comparison. First option is to compare all cases from selected group with each other. This serves the purpose of retrograde control of liquidated damages. Second scenario allows to compare new incident cases to those already analyzed, which is happening during new incident solving process. Third scenario covers comparison of two sets of event against each other which is used for detecting duplicities in data of multiple insurance companies.

5 Conclusion

Usage of local descriptors appears to be a good way how to detect insurance frauds based on pictures attached to the documentation. Currently, there are several Proof of Concept projects whose purpose is to find the best way of implementing these tools in five insurance companies in Central and Eastern Europe.

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INFORMATION SOCIETY AND IT EDUCATION

An Intelligent Information Technology in the Management of Trading Enterprises

Olexander Beley[1], Volodymyr Chaplyha[2]

Abstract. That considers the question of choosing the managers of the places where future commercial enterprise will be located. In the article implemented the choice of the most important factors for the formation of decisions managers in trading companies. These include the buyers and frequency of their occurrence in the selected place. Mathematical models allow formalizing the relationships and dependencies among the key factors of location of the commercial enterprise. For solutions the model proposed to apply the intelligent information systems and the modern means of computer data processing.

Keywords: trade, enterprise process model, formal, intelligent, information, systems

JEL Classification: C63, D12

1 Introduction

The choice of location of the shop is one of the most important decisions for the company, which operates in the retail trade. On the one hand, the location of the store is determined by the potential number of customers and turnover. On the other hand, depends on the location of the cost of obtaining the rights to build or rent. In addition, store placement affects its image and the image of the brand. But all the costs of commercial enterprise depend on correct forecast of future sales, the most complex procedure when choosing a location.

In terms of active construction of commercial real estate leaders in commercial enterprises there is a need traffic forecasting existing and new outlets. This allows you to identify potential market share and capacity necessary conditions to attract tenants and consumers. Calculations are made to preserve the existing market share and identify competitive advantages. The task of forecasting flows of visitors' objects of commercial real estate can be solved on the basis of assessment of their consumer appeal. As a method

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of evaluating the attractiveness of commercial real estate are widely used model Huff (1964), which has defined subject and purpose of this research.

He described the model definition attractiveness of shopping facility, which provides the ratio: likelihood of attracting customers shopping facility; overall consumer spending on a category in its product outlet; market share trading facility investigated in the study of product categories. This model has spread in solving the task of selecting the location construction of commercial real estate (Severin V. et al, 2001).

There are a lot of different methods and approaches to determining the future location of the commercial enterprise. This is law of retail gravitation Reilly (1931).

With an ever growing competition is needed in the previous calculation possibilities discovery commercial enterprise. It is necessary to define a set of factors that influence the choice of the location for the new enterprise. Impact factors can be traced through the model. And intelligent information systems will facilitate faster and more accurate management decisions (Okabe Atsuyuki and Okunuki Kei-ichi, 2001).

2 Determinants of decision managers of trading companies to choose locations for new outlets

When you select a region and area of trade projected for commercial enterprises should pay special attention to a number of common factors that affect the attractiveness of the geographical area in terms of development prospects of trade and the impact of it. These include: potential and demographic trends in the region, the distribution and level of stable income, household size and composition, the business climate and competition in the region.

Demographic potential area of retail trade is considered to be favorable in areas characterized as population growth due to natural increase (birth rate increase) and because of modern migration (Brabyn Lars and Skelly Chris, 2002). Thus the defining motif is the main specialty retailer (retail chain). Thus, the chain of stores specializing in the implementation of the fashion and business wear for businessmen prefer rich fashionable area of the city, and shops selling toys, - local concentration of families with young children.

In consideration of the business climate in the area of future trade practices store service pay attention to the level of employment - the higher it is, the higher the purchasing power of the average buyer. However, there is always some risk reduction in the future some plants (closing, restructuring, layoffs as a result of improved technology) or areas (reduction of troops, etc.).

Identify the location of commercial enterprises and choose certain administrative-territorial unit required with regard to the existing matching facilities and value, and the behavior, and needs of customers, which is planned to serve.

First select and evaluate specific place, you need to pick a general area location. The choice usually starts with analysis of trends in the economic development of trading activities in certain regions. In general, you need to consider and compare the potential trade in different competitive environments. The final decision is made only after a full analysis of each administrative unit. To the degree value type known company, which creates and traditional habits of customers who will use it, generally determine the type and size of individual administrative units that will be explored. Target groups of buyers strongly influence the location of commercial enterprise, mainly shopping district, in the trade area smaller, formed by a group of stores, or more isolated, but on the main highways and more.

For many types of commercial companies desired location in the so-called shopping malls to have a sufficient number of customers. We offer two different ways to assess the attractiveness of centers for trade buyers:

1) determine the factors that attract buyers in trading center;
2) analysis and establishing the boundaries of the area (the so-called service area), which is now covered by trade.

Factors that attract buyers to trade centers include:

- various commercial enterprises, offering a comprehensive range and choice of goods and services;
- availability of banking institutions and offices;
- idle and good access roads and well-functioning public transport;
- a place for recreation and entertainment.

The advantages for your target group of buyers in relation to the location of commercial enterprises can be formalized in a table 1, which further can be

used to assess the significance of the location of enterprises in various centers of trade.

Table 1 The benefits of trade centers and their attractiveness to buyers, Source: own.

Advantages	Importance	City A		City B	
		Points	Mark	Points	Mark
A variety of types of companies	5	4	20	2	10
Banking services	2	2	4	1	2
The availability of parking for vehicle	3	3	4	3	9
The availability of commercial enterprises	4	5	20	4	16
The degree of attractiveness	-	-	53	-	37

The land on which trade center attracts most buyers, called the coverage area. If you can establish territorial coverage, then you can spend an average estimate of turnover and commercial enterprise at this point to compare the centers of trade.

For comparison, trade centers located around the size of the footprint, you can use the law of attraction retail Reilly (1931). The dominance of one center over another depends on the relative size of the population is directly located around each of the centers and the distance between the two centers. Approximate border area coverage (in kilometers) a center of trade compared to the second can be calculated using the formula:

$$border\ area\ coverage\ Center\ A = \frac{distance\ from\ A\ to\ B}{1 + \sqrt{\frac{number\ of\ population\ B}{number\ of\ population\ A}}} \quad (2)$$

How true picture makes this method depends on the impact that population has the size, quality and, consequently, the center of gravity of his trade. It may happen that the mere population may not be directly related to the involvement of buyers in trading center. Also not taken to consideration the relative accessibility of trade center and the presence of public transport. When

using this method have to deal with complex issues and opportunities virtually isolate quantify the city, to which the trade center.

For smaller settlements and villages that are not part of large urban areas, the problem usually does not occur, and for them, this method is ideal. Separate town or village can be isolated and receive data on the population in local government. But if you want to determine the coverage area of the two centers of trade in the territory of the city, this method is unacceptable. Output is that taking into account the specific situation in the model population is replaced by other more important criteria or method used localization buyer, taking into account the characteristics of groups of buyers are interested in trading company. The technology of using this method is implemented in the following order:

1) determined desirable to potential buyers benefits of trade center;
2) benefits determined by the importance of each group of customers. It uses a scale, for example, from 1 to 5: 1 - not very important, 5 - most significantly;
3) measured by scale (number of points) each trading center; take into account the availability, relevance and quality of each preference (eg, 0 - do not have; 5 - fully meets the needs of customers);
4) each trade center receives points for each preference by multiplying the index of significance to the number dialed points;
5) general measure of attractiveness to buyers is calculated for each trade center by adding the points are scored every advantage.

Defining the border area coverage, go to study features buyers purchasing trends and economic development of the region (territory) designated for placement of commercial enterprise. You can use a table of questions and answers below (Table 2).

Having answers to questions with boundaries defined area of coverage can calculate the potential value of possible (future) sales (turnover). Potential implementation defined area of coverage is the product of the actual number of customers for their spending on the type of goods, which will trade company. Also need to know:

- potential buyers in the coverage area;
- average spending per buyer or a family for a certain period (week, month, year).

Table 2 Characteristics of coverage areas, trends and stability, Source: own.

Question	The answers, action	Harmonization. Decision-making
What are the plans for the development of the territory	Assessment of the likelihood of construction, the opening of new commercial enterprises (their types)	Introduction to the perspective plan
How stable economy in the region	Estimation of prospects of development of the region	Introduction to the perspective plan
How active is profitable commercial enterprises in the region	Introduction to data of commercial enterprises in the region	Conclusion. Acceptance to the attention of the main indicators of trade enterprises
What are the basic characteristics of the population served	The study of income and expenditure of public areas	Conclusion
What is the total population in the area of coverage	Report on the census, local statistics, the electoral map	Conclusion

This information can be obtained from the balance of revenues and expenditures (BRE) Regional Statistics Department, when servicing or own research, or of both. For the correction data base of specified region inflation initially calculated the percentage price increase for the period based on the general index of retail prices.

In assessing surveyed and mapped locations of the new commercial enterprise with possible detail degree is considered the following factors:

1) traffic (location of points of access roads). Set inquiries customers directly to the location of the new enterprise;
2) availability of public transport and parking places. Approaching the car parks and public transport is important for the preservation of the respective (target) amount of customers;
3) compliance with the surrounding environment, the presence of a running area leads to reduction of the buyers flow;
4) the presence of existing commercial enterprises located in the area of coverage of the new company. It should be very carefully relate to the definition of potential competitors. You need to ask and answer some basic questions, such as:
    a) will be around commercial enterprises able to expand because they sell products compatible?

b) they compete with the new enterprise for the same customers and the same type to buy this product?
c) they go at odds with the image of a new business venture?

3 The use of intelligent information systems in the management of commercial enterprises

For managers of commercial enterprise specific features are:

1) main and subordinate objectives specific space-time continuum that persecuted them (or have pursued) in the performance of its functions;
2) evaluation indicators and determine the real state analysis and assessment of confidence in them;
3) the procedure of forming lines out of situations that occur in any given period of time and score obtained confidence in the decision-making options.

On this basis, defined blocks of which shall consist of intelligent information management system trade enterprise of "supermarket". Currently, Ukraine operates hundreds of commercial enterprises of different ownership forms, which have a membership unit of information support for major management and a number of auxiliary functions.

Recently supposed to introduce the following main blocks (filling various sizes) of IIMS commercial enterprises as:

1) diagnosis financial condition of the company;
2) develop general recommendations;
3) develop quantitative recommendations;
4) calculations;
5) maintaining databases and database rules.

The blocs of IIMS, which is consideration in the form of advisory and analytical system with elements of an expert system, shown in Fig. 1.

Consider in detail the purpose of each of the blocks. The arrow shows the direction of information flow. As seen from the scheme (Fig. 1) base rules (BR) and the database (DB) are organized separately, as created, adjusted, processed on different paths.

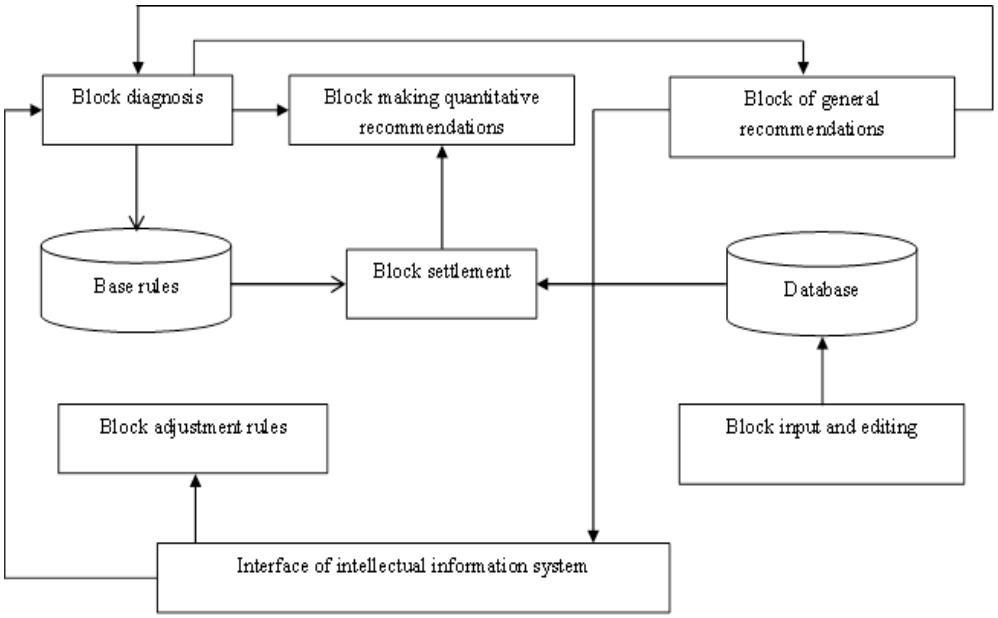

Figure 1 Scheme linkages main blocks of intelligent information management trade enterprise, Source: own.

Base rules proposed to draw up a set of structures like "if so" that allows us to identify (define) diagnosis. In this context serves as a digital database analysis, allowing for the established rules formulated decisions

The block contains procedures for diagnosis manipulation base rules and database. These procedures are performed using special "indicator" tables of formation diagnosis text tables forming recommendations.

Block functions make recommendations based on the information that comes from the power of diagnosis. Its purpose is to issue (formation) vector-quality characteristics of the state commercial enterprise (usually ABC-analysis, SWOT-analysis) and directions out of the situation that was considered appropriate manager.

Block making quantitative recommendations involves the formation and issuance diagnosis of specific numerical values of metrics to achieve in the coming period. It uses power calculations, which are formal descriptions of the indicators. This block continuously (or periodically) updated with new formulas or conditions you need to better adapt to changes in the driving mechanism of management of commercial business.

Consider the basic aspects of the intellectual information management system of commercial enterprise, using the schematic diagram, shown in Fig. 2.

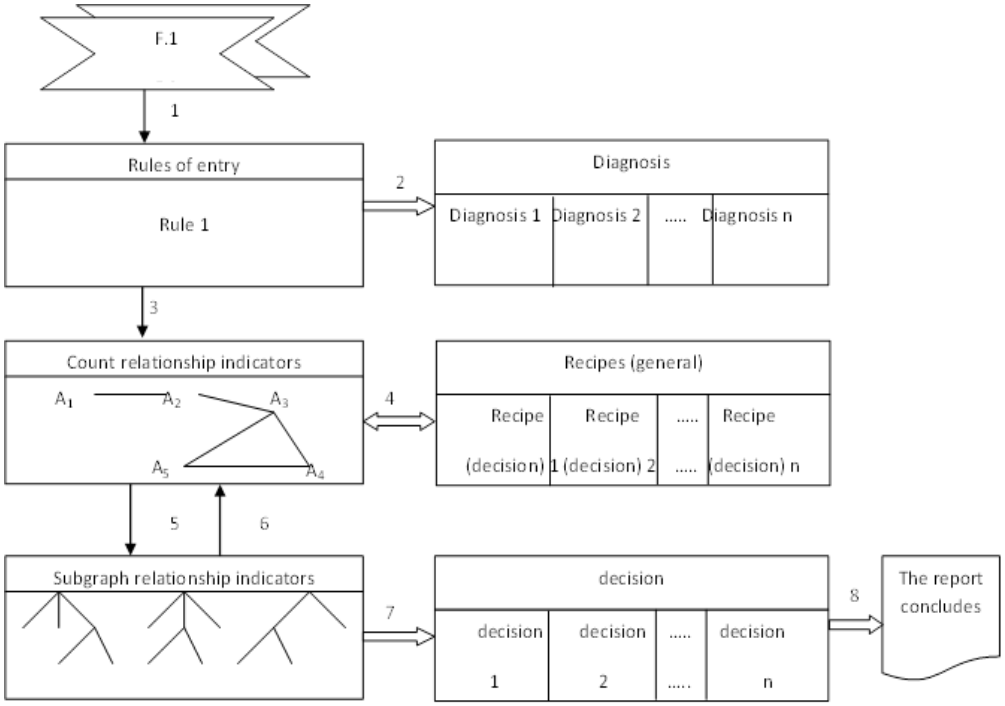

Figure 2 Schematic diagram of the intelligent information management system of trade enterprise, Source: own.

Initialization block diagnosis allows activating work inference rules, the initial information which is in the input forms F.1 and other. This condition, which is a commercial establishment at a given time is identified with one of the rules on the basis of a comparison (or approximation) of the conditions.

This results in a diagnosis and published (analytical table) company. In addition, on his number of the diagnosis identified with special tables (and if not-formed) the text of the diagnosis and the managerial action is passed clearance procedure of recipe. It specified targets (set) and real (actual) values of financial position, controlled by the manager. The difference between the current values of the indexes and serves as planned initial information to find relationships in column formation of key indicators of the summit, which has the largest deviation. Definition of the first peak in the graph parameters (subgraphs of the relationship indicators) sequentially and depending on the size of the previous ones. The first indicator to be analyzed a transition to the

next meaningful indicator for the top of the main column after determining. New values of this peak are calculated based on the formula of its dependence on the previous vertices in sequence.

After that, all indicators on which this peak depends are translated using the new values. The process is considered complete if the value of the main peaks of the graph and subgraph listed. As a result, emerging analytical control value as interim and final indicators used to make decisions based on specific managerial situations.

IIMS is designed for specific purposes and requirements of a situation that requires decision making and management specific state trading enterprise provides adequate justification platform solutions. This specificity of the space-time continuum and objectives of management of business processes performance indicators database of commercial enterprise not only serves as initial information, but also creates a sequence of execution, according to the authors, decision-making procedures.

The proposed concept of building up IIMS meets main goal of management of commercial enterprise, namely to ensure effective management of all system components. Achievement of interim goals by various technological methods provided in IIMS different business units from its commercial enterprises providing that depend on what is laid the foundation of financial stability and factors of its formation at a particular time. Designed by the authors IIMS option on the principles of "input" indicators as illustrated by the graph in figure 3 and formalization rules sequence (tree) indexes are shown in table 3. But for the purposes of establishing the effective management of the supermarket one main purposes of decision trees is not enough: the need for detailed quantitative descriptions of economic conditions and processes are analyzed. For this the generalized tree formation of parameters is divided to the required number of parameters and determined the direction and the intensity of change (increase (+) decrease (-) level (%)).

Each sub-index is expressed through different impact on achieving the main goal, the degree of exposure is controlled enterprise manager by entering the relative importance factor (RIF). The formal establishment of the condition for its commercial enterprise serves to determine its value in fate, when the amount of each goal is unity.

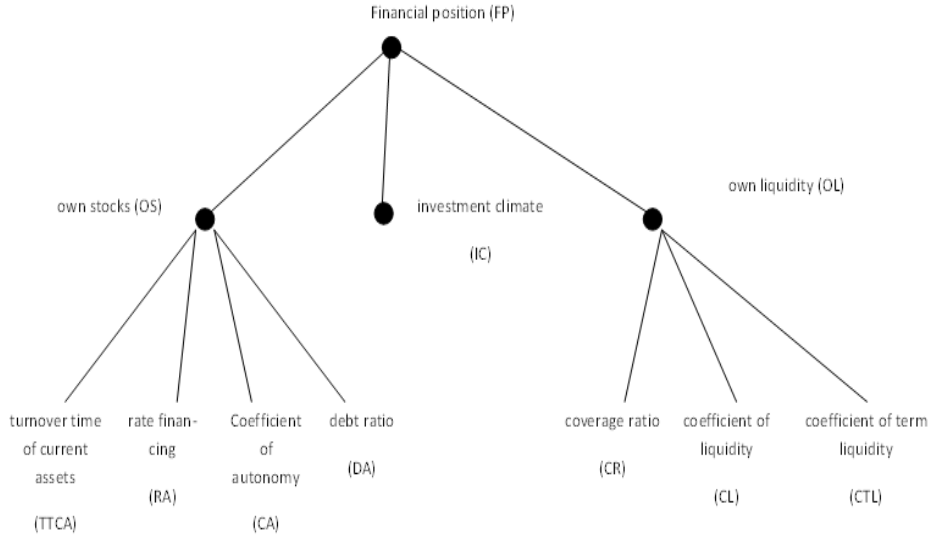

Figure 3 The tree goals of intelligent information system in the management of trade enterprise, Source: own.

Table 3 Table Regulations formalize objectives tree of intelligent information management trade enterprise, Source: own.

number of level	The code aims (sub)	Name goals (sub)	number of level	The code aims (sub)	Name goals (sub)
		High level	2	OS	Effective use own resources
1	FP		2	IC	Favorable investment climate
			2	OL	High liquidity
		Effective use own resources	3	TTCA	Reducing treatment time current assets
			3	RA	The stabilization coefficient funding
2	OS		3	CA	Increased autonomy factor
			3	CR	Reducing the debt ratio
			3	CR	

					Increased coverage ratio
		High liquidity	3	CL	Increased liquidity ratio
2	OL		3	CTL	Increasing emergency liquidity coefficient

Financial status also invited determined by formal rules diagnostics that are in Knowledge Base IIMS by structural formula "if-then". Thus, the choice of ways to improve the commercial enterprise carried out automatically based on assembly of mainly quantitative recommendations.

Without going into details, we note that the diagnosis of the financial condition of any commercial enterprise can be placed only when there is a corresponding knowledge base. For its construction suggest using indicative matrix type:

$$X = \begin{pmatrix} X_{11}^{\Pi} & X_{12}^{\Pi} & \dots X_{1n}^{\Pi} \\ X_{21}^{\Pi} - X_{21}^{\Pi-1} & X_{22}^{\Pi} - X_{22}^{\Pi-1} & \dots \; X_{2n}^{\Pi} - X_{2n}^{\Pi-1} \end{pmatrix}, \qquad (2)$$

where $x_{ij}^{\Pi} = \begin{cases} 1, when\ x_{2j}^{wh} \le x_{2j}^{\Pi} \le x_{2j}^{n-1},\ або\ x_{2j}^{wh} \ge x_{2j}^{\Pi} \ge x_{2j}^{n-1} \\ -1, when\ x_{2j}^{wh} < x_{2j}^{\Pi} > x_{2j}^{n-1},\ або\ x_{2j}^{wh} > x_{2j}^{\Pi} < x_{2j}^{n-1} \end{cases}$, x_{1j}^{Π} - change of the indicator analyzed (j – indicator, п – period), x_{2j}^{Π}, $x_{2j}^{\Pi-1}$ - important indicator that analyzes the current п and previous п-1 period's.

This indicator x_{1j}^{Π} takes the value 1 if the figure increased or decreased compared to the previous period, but reached its (planned) optimal value, and the indicator is -1 if deviated from its optimum value (increased or decreased).

Matrix, which is based on these principles, allows setting the general trend of the functioning of supermarket. This indicator "changes" is calculated as follows:

$$\overline{X^{\Pi}} = \sum_{j=1}^{n} X_{IJ}^{\Pi} \qquad (3)$$

where X_{IJ}^{Π} - indicator changes indicator X_{2j} for the period n; n – number of indicators analyzed.

It is interpreted as follows: if $\overline{X^{\Pi}}$ <0 means that most of the indicators in the period n deviated from its optimum (planned) values; if $\overline{X^{\Pi}}$ =0 - there is a balance of positive and negative changes in period n; $\overline{X^{\Pi}}$ >0 - stable financial position, as most of the indicators improved (deviated in the best way).

Formation of recommendations for management decisions thus has two options:

1) pre-populated forms of reporting documents (forms) are issued without a change in the order confirmation proper diagnosis;
2) recommendations made up depending on the results of diagnostic analysis or the calculations.

This option is recommended (1) used in the identification of simple diagnoses, prescriptions which largely standardized. These include: changing strategies borrowed funds through financial instruments; change the asset balance as the results of economic and financial activity are not teetering; change the rules of distribution of profits as the rate of turnover below the growth rate of economic return and so on.

Implementation of the second option already requires implementation in two ways:

1) each recommendation in the form of phrases selected templates from the catalog-based conclusion as the case;

2) set phrases templates for each pre-generated recommendations, with the exception of certain key phrases and measuring data on the analyzed indicators.

The phrase templates, whose number is determined by the specific trade enterprise, based issuing apparatus resulting forms documents.

Databases used in the functioning of such intellectual information system include multivariable data array sin the form of hypercube. With these structure managers of trade information management system can now instantly receive the required set of data for accurate analysis and decision almost perfect solution.

The model representation of trading process based in the form of hypercube (Fig. 4), where the number of ribs corresponds to spatial-temporal values. It indexes are in a certain place that is made in order to simplify addressing him.

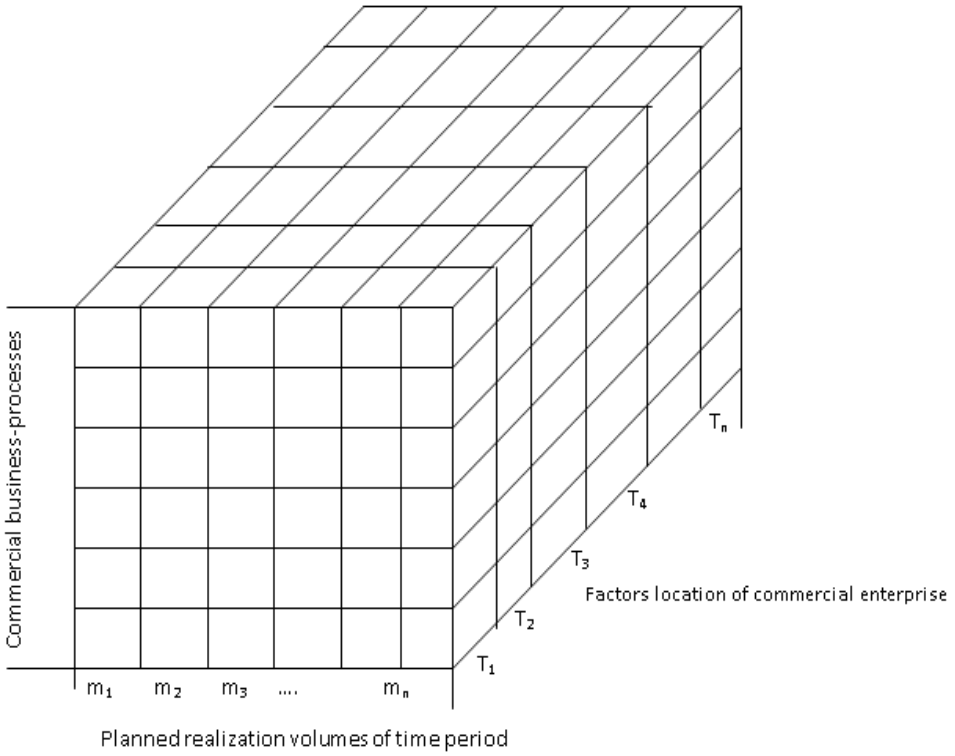

Figure 4 Model representation trade processes depending on factors location of commercial enterprise in the form of hypercube, Source: own.

Views appropriately in a hypercube clearer and clearer manager than formal set of tables. This allows you to build analytical formal requests to IIMS. In addition, the use of multidimensional data model leads to a decrease in search time DW, providing performance analytical queries in real time. Thus, the "Information" hypercube can be implemented within the relational model, and exist as a separate specialized databases for each business process multidimensional structure IIMS.

The situation where the analysis of a business process should have all the information that is in storage, there is seldom enough. Since each manager-analyst serving individual business processes commercial enterprise, he first needed data describing precisely the elements of the business process (operation). Usually, the actual amount of data does not exceed the limitations that are characteristic of modern multidimensional database. Therefore, there is the idea of the selection of data that actually require specific managers in separate sets. These sets sold in a specialized multidimensional database. But the source of data for a centralized data warehouse serves IIMS commercial enterprise.

4 Conclusion

Artificial intelligence is increasingly implemented in daily life. They replace the man in many areas of activity, from working in the factory and the financial Games of shares on stock exchanges. And also in various administrative processes, allowing faster and more accurate decision manager. Of course, artificial intelligence used the trading activities in the planning of resources and development strategies.

We in the article the use intelligent information search system for the future location of commercial enterprise. This is the stage of business planning and development of the project. It is important to remember that the ideal place to find and achieve his placement of the new commercial enterprise is a complex organizational and functional tiered task manager (as any place has both positive and negative). But managers need to understand that requests groups of customers, which is going to serve a new commercial enterprise have in the future will be crucial.

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Teaching of Real-time Systems with Witness Support

Miroslav Dišek[1]

Abstract. The main aim of this work is to introduce simulation model branch in business process to beginners by simulation instrument Witness. Advantage of this instrument is that we can use experiment on simulation model, which could not be happened in real time. The work divides in theoretic part, focused on basic term, which is needed to control simulation instrument Witness. Another part is focused on instrument itself and its short introduction. The last part is focused on teaching Real-Time systems on Universities and its benefits of simulation instrument Witness for students.

Keywords: Witness, Model, Simulation, Real-time, Systems, Teaching

JEL Classification: A20, I25, M53

1 Introduction

The first step for study of real system behavior is design and creation of its model. Creation of model of the examined system enables exploring and subsequent streamlining in following steps. Modelling of the real system also contains unreplaceable abstractions in several cases. These abstractions represent difficult or negligible aspects of modeled system. Heterogeneous parameters or relations belongs to most often phenomena of these abstractions. Abstraction could be therefore understood as part of the system with its own character. System defines set of elements, which are linked together by some relation. Set of elements and their relations create one complex – System. Some attributes are then added to those systems by their character – manufacturing, economic.

Systems classification:

Static – systems abstracting from time

Dynamic – their behavior is time dependent (events – created one after one, the first precedes the second). It should be said that simulation deals only with dynamic systems.

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2 Real Time Systems (RTS) – definition of OS

Processes asynchronous events and under all circumstances produces reactions to all these events in fixed time. Systems are divided into two basic categories (HARD a SOFT REAL-TIME), the difference resides in compliance of time constraints, laid on the system functions. Operational system of real time is such system, wherein correctness of calculation does not depend only on logical correctness of algorithm, but also on time, during which the result was received. If the time constraints are not fulfilled, the system is said to fail.

Typical characteristics of RTS

- event driven, reactive
- its failure is expensive and dangerous
- parallel/more threads programming
- continuous operation without operator intervention
- requests for reliability and fault-tolerance
- predicable behavior

3 Simulation

Mimicry of real system activity in time flow, when progression of real system behavior can be examined with the help of simulation model.

Newton (1687) - „Mathematical basis of natural philosophy "– usage of the method of analysis of the systems, the foundation of analysis is creation of abstract model of real system by so called simulation.

Simulation lets you explore an electronic model of the project you manage - whether the project is a factory, or a hospital, or an administrative center, whatever. The type of simulation it provides is time-based, and takes into account all the resources and constraints involved, and the way all these things interact with each other as time passes (Dlouhý et all., 2007).

The purpose of creating simulation model is to achieve higher production effectivity and this process is called a reengineering. The reengineering is a part of a company strategy and this very process have to fulfill basic key pillars (Ministr, 2013). Among these pillars belong for example process mapping and other. The process mapping is the last step before fully effective reengineering (Gála et all, 2009).

3.1 Reengineering

„Basically, reengineering is a complete reassessment and radical reconstruction (redesign) of company processes in order to achieve dramatic improvement from the perspective of critical efficiency measures such as costs, quality, services and speed (Hammer and Champy, 2000).

3.2 The process

„The process is an organized group of interrelated activities and/or sub processes, which pass through one or more organizing entities, alternatively one (the company process) or more cooperating organizations (an intercompany process), which consume material, human financial and information resources and the output is in the form of a valuable product for external or internal customer (Šmída, 2007).

3.3 Process mapping

“Process mapping provides tools and proven methodology for identifying your current 'As-Is' business processes and can be used to provide 'To-Be' map (Řepa et all, 2007). It is proven to be analytical and communication tool intended to help you improve your existing processes or to implement a new process-driven structure in order to reengineer your business processes (Hunt, Pour and Šedivá, 1996).

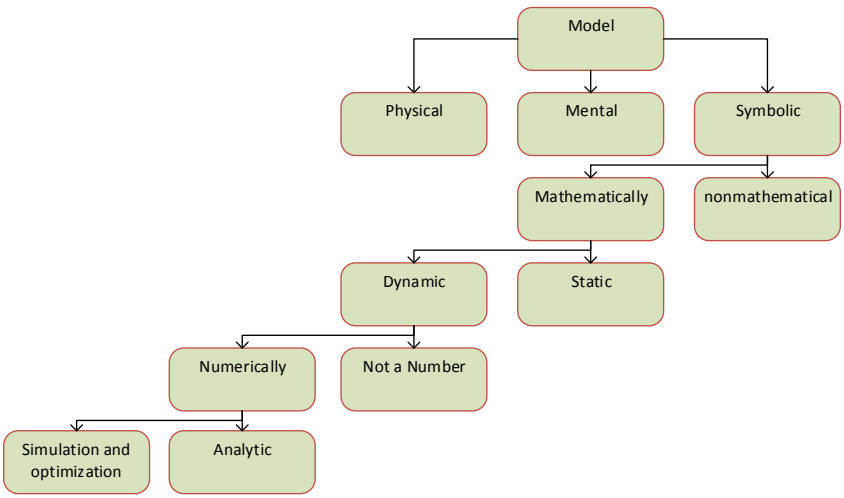

Figure 1 Classification of simulation modules, Source: own

4 Possibilities of usage of Witness in the university education

Witness application was developed by British company Lanner Group Ltd. and belongs to most used and widespread SW for simulation and optimization of manufacturing, logistics and service systems. Witness belongs to system, which are determined for support of manager's decision using created simulation models, which are subject of subsequent experiments. Created simulation model, based on the up-to-date state of knowledge, enables us to forecast better its behavior in the future.

The core of Witness is created by modules for optimization of processes and virtual reality visualization. Witness also enables bidirectional exchange of information with Microsoft VISIO tool, linkage with CAD/CAM systems and module documentation.

Modeless created by Witness tool show movement of material or clients through studied system, state of individual parts, performed operations, current usage of resources. Each and every event is filed. User is thus enabled to watch dynamics of the process by chosen criteria. Witness could be used for analysis of any kind of processes, in which influence of any change is manifested and to quantify solution alternatives in substantial way. Tool not only enables creation of models which are in close relation to reality, but also possibility to work interactively with model under study. Witness, thanks to its inherent attributes, offers big flexibility in the range and focus of simulation projects. The purpose of the application is to be simple for every user (DYNAMICFUTURE, 2015).

- Production
- Implementation of modern ways of solution
- Capacity planning
- Bottleneck identification in the production
- Quality measurement
- Technology
- Guiding logic of material flows
- Planning management practices (DYNAMICFUTURE, 2015a).

Simulator utilizes simulation principles with discrete events. Simulation, driven by discrete event is defined as simulation, in which variables are

changed only in discrete time moments of event occurrence. Simulation concept includes system, events, model, entities, attributes, state variables, processes and activities, which together define event driven simulation.

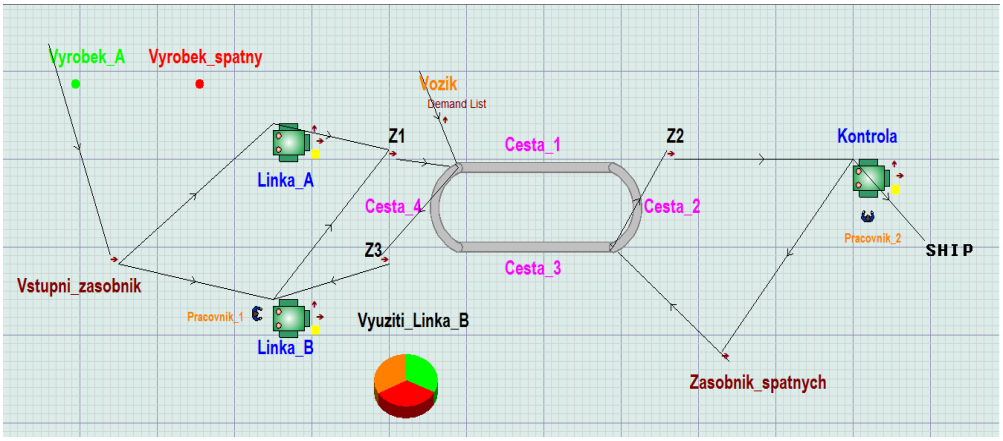

Figure 2 Illustration of Witness14 Source: own

5 Possibilities of Witness usage in university education

If user succeeds in creation of conceptual model of the process and is also capable to implement it in discrete simulation tool, WITNESS will simulate production process fully functional. Advantages of WITNESS simulation tool are based mainly on the level of sophistication of simulation languages. Comparing with other tools, WITNESS can take beginning user by its topology and possibilities in the area of experiment. During creation of conceptual model, a beginning user can realize a complexity in the area of item placement with the respect of further possibility or recognize item in the overall model, to recognize its function and relations to other items in the same model. The total preparation before the implementation itself has to be as simple as possible and easy to understand. In the process of familiarizing with the WITNESS interface user can have problems with his (her) basic lack of knowledge and maybe with the changing meaning, appearance and placement of several functional buttons and other options. During usage of basic operations before conceptual model implementation user can meet problems e.g. to make possibility of *Tracks* element banding functional (can be solved by special combination of keyboard shortcuts and mouse clicks, not very intuitive for beginner). The creation of static structure itself uses to pass of

without problems and user can utilize its creative skills (concerning graphical layout mainly), meeting fixed conditions from conceptual model in the same time. During creation of dynamic structure users often contend with the problem of wrong timing of the input - e.g. products into simulation model. Products can such enter model sooner than the element for transport is capable to handle them and they start to cumulate. After longer time period of testing time differences of input, output, loading and unloading time of products user will be capable to create compatible relation between all elements. Witness is capable to provide statistical outputs after finalizing implementation of all elements and their relations. Based on this outputs user can subsequently investigate how to streamline and speed up the whole process, for example by change of transport means, regrouping ways, decreasing or increasing stacks capacity, adding or removing another working line – all without intervention into standard workflow.

6 Conclusion

Teaching Real-Time systems is for students on Universities beneficial. Student, who is familiar with basic functions productive process in factories can find failures and effectively repair it. Based on knowledge of simulation theory and introduction of simulation instrument Witness, user will be able to create his own conceptual model with its own static and dynamic structure, which may be compared with real process. This area has really big potential and it is able to save a lot of financial recourses and time.

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A Comparison of Web Accessibility Evaluation Tools

Paweł Konkol[1]

Abstract. The recent development in the area of web applications, websites and services is connected with the growing importance of providing better access for people with various sorts of disabilities. Benchmarks and standards in this area determine the path each web developer should follow to meet the needs of disabled people. These standards refer mainly to the Web Content Accessibility Guidelines (WCAG) 2.0 elaborated by the W3C Web Accessibility Initiative (WAI) - the most important list of recommendations in this area.
This article presents the comparison of the web accessibility evaluation tools which are now available to test whether a particular web service meets the web accessibility standards. Testing based on these tools helps to comply with rules and obligations providing better access and usability of Web products for people having one or multiple forms of disabilities.

Keywords: web content accessibility, web accessibility evaluation tools, web accessibility standards

JEL Classification: C80

1 Introduction

According to Tim Berners Lee2 the power of Web is linked to its universality and everyone should have Web access regardless of possible disability. United Nations' Convention on the Rights of Persons with Disabilities from the year 2006 underlines that the Web Accessibility (WA) is a basic human right (DSPD, 2006). Many improvements are needed in this area. Report on WA elaborated in 2016 by the Polish Widzialni Foundation (Fundacja Widzialni, 2016) informed about 22,9 % of Internet pages of Polish public administration institutions which complies with the level AA of WCAG 2.0 (comparing to 1,7% in 2013).

The article discusses the set of the main present WA standards to which reference is made in the Polish National Framework of Interoperability (RMRP, 2012) and the comparison of the selected web accessibility evaluation

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[2] Director of W3C, inventor of the World Wide Web Consortium

tools which test web services against these standards. These tools can significantly save the time when providing accessibility.

The next paragraph describes main Web accessibility standards which serve as the reference in WA state regulations in Poland. Third paragraph presents selected tools for automatic validation of web accessibility. Then the comparison of these tools is presented and, as a result, ranking based on their various functionalities.

2 Web accessibility standards

WCAG 2.0 Guidelines list recommendations for Web Content Accessibility referring to all type of content that is used in the Web. In 2012 WCAG became an ISO International Standard (ISO/IEC 40500:2012). Some countries implemented their own regulations which implies, especially on public institutions, compatibility with the rules of web accessibility. Just to mention a few – in 2010 British Standards Institute released the standard BS 8878:2010 Web accessibility. This set of recommendations is focused on how to comply with UK Disability Discrimination Act 1995. Similar approach concerns standards for section 508 of the 1998 amendment of the US Rehabilitation Act Code of practice.

In 2012 Polish Council of Ministers adopted Polish National Framework of Interoperability which includes directly reference to the A and AA level of compliance with standards listed in WCAG 2.0 (W3C, 2008). This National Framework refers to four main principles of the WCAG 2.0 guidelines which requires from Web information to be: perceivable, operable, understandable, robust. The table below presents most important standards that Polish public web services have to follow:

Table 1 Main Web accessibility standards in Polish regulations, Source: own.

Principle	Positions from WCAG 2.0 Guidelines	Brief summary
Perceivable	1.1	Text alternatives for any non-text content - it can be changed into other forms people need, such as large print, braille, speech, symbols or simpler language
	1.2	Time – based media : Alternatives for time-based media

	1.3	Adaptable - content that can be presented in different ways (for example simpler layout) without losing information or structure
	1.4	Distinguishable: facilitating users to see and hear content including separating foreground from background
Operable	2.1	Keyboard Accessible - all functionality available from a keyboard
	2.2	Enough Time - users have enough time to read and use content
	2.3	Seizures: Do not design content in a way that is known to cause seizures
	2.4	Navigable - ways to help users navigate, find content, and determine where they are
Understandable	3.1	Readable - text content readable and understandable
	3.2	Predictable: Web pages appear and operate in predictable ways
	3.3	Input Assistance: Help users avoid and correct mistakes
Robust	4.1	Compatible: Maximize compatibility with current and future user agents, including assistive technologies

3 Web accessibility evaluation tools

The tools presented below were chosen to present the diversity of solutions for automatic Web accessibility evaluation. One of the choice criteria has been the possibility of use free of charge (at least for public institutions). Another important feature has been the WCAG 2.0 as the accessibility guidelines with standards to check against.

3.1 WAVE - web accessibility evaluation tool[1]

The tool has been developed by WebAIM (Web Accessibility In Mind) initiative based at the Center for Persons with Disabilities at Utah State University which provides various accessibility services, products and trainings. Accessibility feedback is presented using icons placed on various parts of the website being evaluated which highlight the content that need to be checked against accessibility standards. WAVE can be add – as extension – to Chrome which ease the evaluation. This enables testing of web pages in Intranet. In general WAVE service does not result in a statement or approval that a page is or is not accessible. It presents the list of "accessibility issues"

[1] http://wave.webaim.org/

which have to be taken into consideration by a developer. WAVE can be used in “no CSS” option and provide rich feedback on contrast compatibility.

3.2 Utilitia[1]

This WA evaluation tool is offered by the Polish company Utilitia focused on various aspects of accessibility. Utilitia evaluation tool offers testing against WCAG 2.0 standards at A, AA and AAA levels which corresponds with requirements of Polish National Framework of Interoperability. In addition, it offers general testing of HTML and CSS using W3C validators. Utilitia with advanced features is not free but public administration institution can use it if free of charge. In general, this tool offers 24 validators which can be used in various combinations. Utilitia, contrary to the majority of tools available, tests also subpages of the service submitted for evaluation. The advantage for Polish institution is also Polish as the language of user interface.

3.3 A-Tester[2]

Developed by Evaluera Ltd which offers software solutions and expertise assisting in coding more accessible services and website. A-Tester is aimed to meet WCAG 2.0 standards for web pages created with progressive enhancement. The pre-enhanced version of a website is designed only with HTML, with no support for scripts, non-HTML plugins or styling. It evaluates a pre-enhanced version of a website designed with progressive enhancement against WCAG 2.0 Level-AA conformance statements. In case A-Tester finds some part of the code as not compliant with WCAG 2.0 standards, the result is presented as the detailed description. It can firstly show the places in the of the code that are not compliant with the WCAG standards and then the list of statements confirming compliancy with the WCAG standards. The other way of ordering the results is to go through each of the WCAG success criteria at AA Level with information about the compliance.

3.4 Cynthia Says™ [3]

Cynthia Says web content accessibility validator is an evaluation tool offered by the Cryptzone Cynthia Says™ portal which is the collaborative initiative of

[1] https://validator.utilitia.pl/
[2] http://www.evaluera.co.uk/
[3] http://www.cynthiasays.com/Home.aspx

Cryptzone Inc., International Center for Disability Resources on the Internet (ICDRI), and the Internet Society Disability and Special Needs Chapter. The portal run by Cynthia Says provides education resources in the area of Web accessibility. The free Cynthia Says Validation and Reporting Technology concerning Web accessibility is based on the Web Test interface of HiSoftware Compliance Sheriff. This is the commercial solution for monitoring and testing accessibility of entire websites. It can be applied to validate documents, libraries, email, social and collaborative media content against company standards for accessibility. After submission of a webpage for Cynthia Says tool, a real time report is presented. In the process of evaluation, the content of a specific web site is downloaded from the Internet, the evaluation checking compliance with accessibility standards starts and, upon completion, the report is generated. Before starting the process, there is an option to select the compliance checking point group that the webpage should be checked against. The options include: Section 508, WCAG 2.0 A, WCAG 2.0 AA, WCAG 2.0 AAA.

3.5 Web Accessibility Checker[1]

Provides feedback with the list of problems which are classified as known (certain problems which must be fixed), likely (may pose accessibility barriers, the decision about modification should be taken by a developer) or potential (warnings about problems whose impact on accessibility cannot be decided by the Web Accessibility Checker). This evaluation tool offers several options to customize evaluation process. One of the most useful is the possibility to choose the guidelines to check against (i.e. Section 508, Stanca Act, WCAG 1.0, WCAG 2.0) and the level of compliance. Another helpful future is the option to upload an HTML file or past the HTML source code. This means the possibility of evaluating part of the webpage instead of running the process through the whole code of the webpage being evaluated.

3.6 European Internet Inclusion Initiative Checker (EIII Checker)[2]

Checking tool designed and implemented during realization of the EU Project called European Internet Inclusion Initiative. The project has been focused on

[1] http://achecker.ca
[2] http://checkers.eiii.eu/

the development of collection of services in a new combination of existing automated evaluation tools for accessibility. EIII Checker detects barriers of a website and provides reports concerning various places of the code of the website that should be further considered by human against accessibility standards.

4 Web accessibility evaluation tools ranking

The growing number of evaluation tools is an implication for comparison of these assistive technologies. The comparison presented in this article was focused on standards that each tool uses as a benchmark. The aim was also to check whether they enable to choose level of conformance with standards, do they provide clear information on validation results with explanation about type of the error, how easy the part of a website with errors can be located.

The table below presents result of the comparison with an attempt of ranking tools from the most practical and useful, especially in the context of Poland. The WAVE validator which is on top of the list, compared to EIII Checker being on the last position offers various WCAG 2.0 conformance levels option. Another advantage of the WAVE is a plugin offered for Chrome which fasters the evaluation. This enables also to check Intranet services and restricted or password protected pages. WAVE is also the only tool which provides graphic representation of accessibility issues directly on the page which have been tested. One of the main advantage of Web Accessibility Checker (WAC), the second on the list, is the possibility to upload HTML file or paste part of the HTML code. WAC uses “probable” approach which not only shows errors but suggests possible accessibility problems that cannot be determined by this tool. The Utilitia provides also various evaluation options but free version is limited only for public institutions in Poland. Interface in Polish also limits the number of possible users.

Table 2 Comparison of selected WA evaluation tools, Source: own.

	Main features
WAVE	various WCAG conformance levels, plugin for Chrome (Intranet testing available), results directly on the page tested, advanced information about contrast errors, clear advices and explanations
Web Accessibility Checker	various WCAG conformance levels, checking against WCAG 2.0. and German (BITV 1.0) or Italian Standards (Stanca Act), report in PDF version
Utilitia	various WCAG conformance levels, testing of subpages, additional HTML and CSS testing using W3C validators, paid advanced options (but free for Polish public institutions), only polish version, slow report generation
Cynthia Says	various WCAG conformance levels, information about errors without clear advices about improvements
A-Tester	Only WCAG 2.0 AA conformance level
EIII Checker	General WCAG 2.0 checking without choosing conformance level, very general and short report

5 Conclusions

The Web Accessibility issues discussed in this article was focused on the WA standards (in particular those used as the reference in state regulations in Poland) and the web accessibility evaluation tools. They can significantly reduce the time needed to identify and eliminate existing and potential accessibility barriers. The results of comparison of the tools showed that they vary in terms of functionalities provided and the method and layout of report presentation. However, it should be emphasized that this automatic evaluation should not be seen as the only solution to avoid accessibility problems. WA assurance and evaluation is a complex process and should be addressed throughout all phases of Web site development (Yesilada et al, 2013).

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Analysis of Student's Course Comments Using Text Mining and R

Jan Manďák[1]

Abstract. Analyzing feedback of customers is important in all areas of business and also in non-business organizations. In this study comments of students at webpage Primat.cz evaluating university subject Operations Research taught at VŠB-TU Ostrava are analyzed. Basic text mining methods are used to extract meaningful patterns from unstructured data. At first comments are scraped from web using Import.io, than this data are pre-processed (e.g. punctuation, numbers, stop words are removed), document-term matrix is created and finally frequent terms are visualized using word cloud, term correlations are found or clusters of words are created. The results of the study show that text mining can be used for exploring student's positive/negative experiences or needs.

Keywords: Text Mining, R, University, Students, Comments

JEL Classification: C81

1 Introduction

An often-cited statistic is that 80% of business data is unstructured, be it in word, excel, power point files, audio and video files, sensors and logs, or external data such as social media feeds (Vidhya and Aghila, 2010). Examples of this type of data could be customer complaints, feedback to services, reviews of products, open answers of questionnaires focused on customers, employees or suppliers or logs of various computer systems. Also non-commercial organizations have access to unstructured data - universities to feedback of students, hospitals to the book of wishes and complaints, municipalities to the requirements of its citizens etc.

Traditional business intelligence systems driven by data warehouses excel at telling us what happened when, but they are not very good at answering why. This question can be answered by analysis of unstructured data, usually in the form of plain text. For this purpose usage of text mining methods is beneficial. Text mining refers generally to the process of extracting interesting and non-trivial information and knowledge from unstructured text

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(Gupta and Lehal, 2009). It is a young interdisciplinary field which draws on information retrieval, data mining, machine learning, statistics and computational linguistics. Because of the high percentage of unstructured data text mining is believed to have a high commercial potential value. Typical text mining tasks include text categorization, text clustering, topic modeling, sentiment analysis or document summarization.

2 Text mining process

In the Fig. 1 there is a high level, general process of text mining (Vidhya and Aghila, 2010). The whole process starts with gathering unstructured data, e.g. from websites, emails, documents etc.

Figure 1 Text mining process

In the next phase, data pre-processing, data are cleaned up, tokenized and usually converted to term-document or document-term matrix. Among data cleaning tasks belong removing punctuation, special symbols such as /"£&%$, numbers, stop words, whitespaces or converting text to lower case. Then data are converted to document-term matrix of term-document matrix. A document-term matrix is a matrix, which consists of documents (in our case feedbacks) in rows, words in columns and numbers in matrix represent frequency of a given word in a given document. Example of document-term matrix is in Table. 1.

comment	předmět	hodně	když	vám	někdo
1	0	0	0	0	0
2	0	1	0	0	0
3	0	0	0	0	1
4	0	0	0	0	1
5	0	1	1	1	0

Table 1 Document-term matrix

Final step of the text mining process is usage of document-term matrix or term-document matrix as an input for descriptive or predictive analytics. Example of descriptive analytics is e.g. clustering of words or documents; example of predictive analytics is e.g. document classification. Email spam filtering is typical representative of document classification.

3 Text mining using R

In this part the whole text mining process for analysis of comments of students at webpage Primat.cz evaluating university subject Operations Research taught at VŠB-TU Ostrava is described. Let's start with the data gathering. Student's comments were scraped from web Primat.cz using import.io service. This service can be used to scrape web data, structure them and save e.g. as CSV or txt file. Sixty comments were obtained from Primat.cz.

R, free software environment for statistical computing and graphics, and its package text mining were used for this analysis. After installation of text mining package *tm* (Feinerer et al., 2008), load of comments into R and creation of *Corpus* (collection of comments), comments are cleaned. Document-term matrix similar to Table 1 is also created, converted to matrix data type and sorted by sums of columns.

```
# Install and load tm package
install.packages("tm")
library(tm)

# Load comments and create Corpus
comments <- read.table("primat_2.txt", header=TRUE, sep=",")
docs <- Corpus(VectorSource(comments))

# Clean comments
docs <- tm_map(docs, removePunctuation)
docs <- tm_map(docs, removeNumbers)
myStopwords <- c("tak",ale","jak","když","ani","nebo","když")
docs <- tm_map(docs, removeWords, myStopwords)
docs <- tm_map(docs, tolower)

# Create and sort document-term matrix
dtm <- DocumentTermMatrix(docs)
dtm_new <- as.matrix(dtm)
dtm_new <- dtm[,order(colSums(dtm), decreasing=TRUE)]
```

When we have prepared data for analysis, we can start to extract some interesting information and visualize them. Word frequencies are counted and

visualized using word cloud, word correlations are computed and words are clustered using hierarchical clustering (Zhao, 2013).

```
# Count word frequencies from document-term matrix
freq <- sort(colSums(as.matrix(dtm)), decreasing=TRUE)
head(freq)
```

```
předmět   hodně    když     vám   někdo  štěstí
     13      10      10      10       9       9
```

```
# Another option is to use findFreqTerms function
findFreqTerms(dtm, lowfreq=9)
```

```
 "hodně"   "když"    "někdo"   "předmět" "štěstí"  "vám"
```

Another popular technique how to visualize frequency of words is word cloud. For this purpose R package *word cloud* (Fellows, 2014) is installed. Created word cloud can be seen at Fig. 2.

```
# Install and use word cloud package
install.packages("wordcloud")
library(wordcloud)

wordcloud(names(freq), freq, min.freq=6)
```

Figure 2 Word cloud of frequent words

If you have a term in mind that you have found to be particularly meaningful to your analysis, then you may find it helpful to identify the words that most highly correlate with that term.

```
# Find words correlated with word “předmět”
findAssocs(dtm, c("předmět"), corlimit=0.5)

$předmět
  tohle     asi opravný  termín     vše   tento
   0.79    0.64    0.53    0.53    0.53    0.52
```

Now let’s look at how particular words appear in comments. For this purpose, it is necessary at first to calculate distances between words and then cluster them according to similarity. Input for this computation is document-term matrix and algorithm used is hierarchical clustering.

```
# Install cluster package and cluster words
library(cluster)
dtms <- removeSparseTerms(dtm, 0.9)
d <- dist(t(dtms), method="euclidian")
fit <- hclust(d=d, method="ward")

# Plot word clusters
plot(fit, hang=-1)
groups <- cutree(fit, k=5)
rect.hclust(fit, k=5, border="red")
```

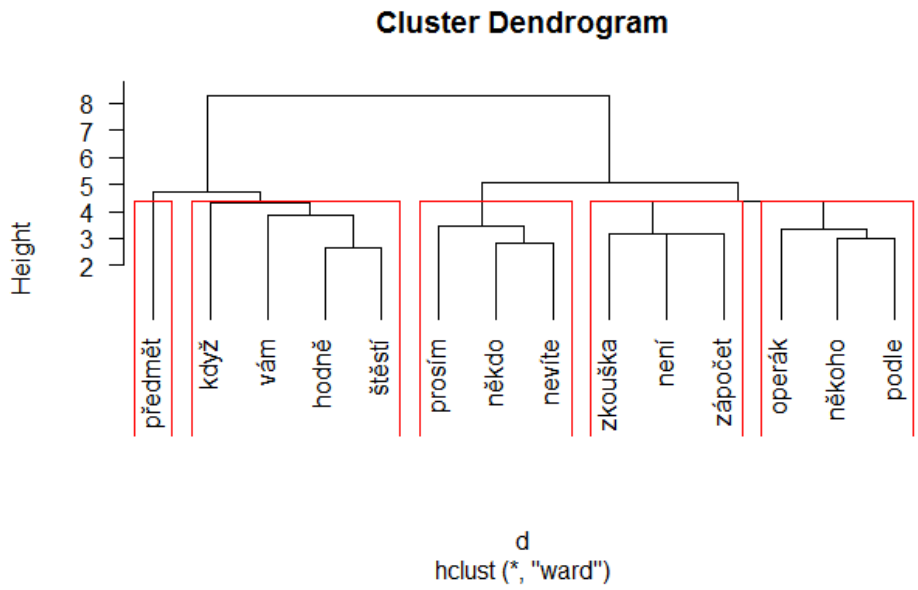

Figure 3 Clusters of words in comments

We can see 5 different clusters - in the first one, there are comments about subject Operations Research as such, in the second one students wish to other student’s good luck, the third cluster consists of questions for help, the

fourth one is focused on exam and the last one is focused probably on comparing particular teachers.

4 Conclusion

In this study basic text mining methods were illustrated with the use of student's comments gathered from Primat.cz website using Import.io. Comments were at first cleaned - white spaces, punctuation, stop words and special symbols were removed and text was converted to lower case. Then from this clean data document-term matrix was computed. Document-term matrix was used as an input for computing frequency of words. Among most frequent words in students comments belong "předmět", "hodně", "štěstí", "zápočet", "zkouška" or "ing". Then words were clustered using hierarchical clustering and 5 clusters were found - e.g. comments focused on subject operations research as such, asks for help or comments focused on exam.

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ICT Professionals Wages in Moravian and Silesian Regions

Lea Nedomová[1], Miloš Maryška[2], Petr Doucek[3]

Abstract. Presented article presents the comparison of average nominal wages of ICT Professionals in Moravian and Silesian regions for the last eleven years. There are analysed data of ICT Professionals in two categories – ICT Specialists (CZ ISCO 25) and ICT Technicians (CZ ISCO 35) - from four regions (Moravian-Silesian, Olomoucky, Zlinsky and South Moravian). The other dimension of realized analysis is gender aspect. With regard for the data, their source is the corporation Trexima, Ltd. which conducts statistical surveys on wages for the Ministry of Social Affairs. We worked with a sample Average Earnings Information System file. Cases involve annual time series and average wages are given in the Czech crowns. The data series are presented for nominal wages as well for real wages after including the inflation rate (source the Czech national Bank - CNB). The comparison is realized to the real wage level for begin of the year 2015. All presented results are compared with average wage in the Czech Republic and with the average wage in profession and gender group. All analysis are realized in MS Excel. Their results are demonstrated in form of graphics and tables.

Keywords: ICT Specialists, real wages in ICT, Moravian regions, Silesians Regions, wages progress.

JEL Classification: J24, M21

1 Introduction

Process of global world's economic integration is being strong supported by the implementation of information and communication technologies (ICT). ICT play crucial role not only in macroeconomic measure, but also on regional and corporate level as well. Concepts of an information society, predicted by Peter Drucker (1969), as such are being further developed, for example, by Frank Webster (1994), who contemplates contemporary society from the

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perspective of five categories – technological, economic, professional, territorial, and cultural.

It is not very surprising that two dimensions are most accentuated in today's technically oriented society:

- technological (use of different information technologies, degree of use of the Internet, number of citizens using ICT in various everyday activities) and
- economic (more precisely, economic-cum-managerial – percentages of profit or GDP expended on investments in or expenditure on ICT, support for certain types of processes through ICT), for the general standard of the Czech economy (Nedomová, Doucek, 2016).

These two dimensions are visible in everyday work of ICT Specialists and it does not matter if ICT Specialists work in business or in public or state administration (Maryska, Doucek, Nedomová, 2015). On one hand they have to implement ICT into business on the other hand they obtain their wages for this work (Doucek, Nedomová;,Maryska, 2015). By this way is significance of ICT and ICT Specialists in society measured by wages and salaries (Bílková, 2015; Malá, 2015). For comparison of wages in Moravian and Silesian regions to another regions of the Czech Republic we used data that have been worked out for Ministry of Labor and Social Affairs.

The aim of this article is to analyze the wages of ICT Professionals in Moravian regions, at first by group of ICT professions (CZ ISCO 25 ICT Specialists and CZ ISCO 35 ICT Technicians) and by gender in the second place.

2 Methodology and Data Collection

This part of the paper contains information about:

- classification of occupational groups of ICT Professionals according to CZ ISCO methodology,
- description of the methods,
- analytical tools that we used for the processing of the results.

Classification of occupations linked to the skills and knowledge required for following them has been developed in the Czech Republic over a relatively long period of about sixty years. In 2011 the Czech Republic switched from

K-ZAM methodology to the CZ-ISCO ones, which divides the ICT professions into the following two categories:

- Specialists in the area of ICT (CZ ISCO 25) – ICT Specialists and
- Technicians in the area of ICT (CZ ISCO 35) – ICT Technicians.

2.1 Classification of Occupational Groups of ICT Professionals

ICT Professionals classification is based on CZ ISCO since 2008.

Specialists in the area of information and communication technologies – these include professions which in economic practice conduct research, plan, design, write, test, provide advice, and improve ICT systems. These activities are performed in the hardware and software area.

Technicians in the area of information and communication technologies - provide support for the operations of computer and communications systems and computer networks. They also perform technical tasks related to telecommunications, broadcasting video, audio and other types of telecommunication signals on land, at sea or in the air.

2.2 Collection and Analysis of Data

The source data were supplied by the Czech Statistical Office (CZSO) for the evolution of the share of ICT Professionals in the Czech economy and determination of the annual inflation rate after deducting it from the nominal wages. We employed the methodology for classification of professions CZ ISCO, which is also administered by the Czech Statistical Office.

The main source of data for the purposes of this article was 'Labour Force Sample Survey', which is conducted every year by the corporation Trexima, Ltd. (http://www.trexima.cz/) for the Ministry of Labour and Social Affairs of the Czech Republic. The data consist of responses from approximately 1,900,000 economic operators active in the territory of the Czech Republic annually. Of these records, approximately 19,000 were about ICT Professionals. Each record contains information about time series identification (identification of the year), economic subject, region of economic activity, person's job classification according to CZ ISCO

methodology, level of education, age of a person, nominal wage of a person in Czech Crowns (CZK).

We processed the collected data using tools and functions of Microsoft SQL Server 2012. Processed data were exported into Microsoft Excel where analysis of the time series was processed. **All nominal wages are recalculated, on the real income level of the year 2015**. Annual inflation rate used in the Czech Republic is presented in following Table 1.

Table 1 Average Inflation Rate, Source: www.cnb.cz

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Annual Inflation Rate in %	2.8	1.9	2.5	2.8	6.3	1.0	1.5	1.9	3.3	1.4	0.4	0,3

Results are presented for group of ICT occupational classification. The second level of analysis was selected by gender.

3 Results

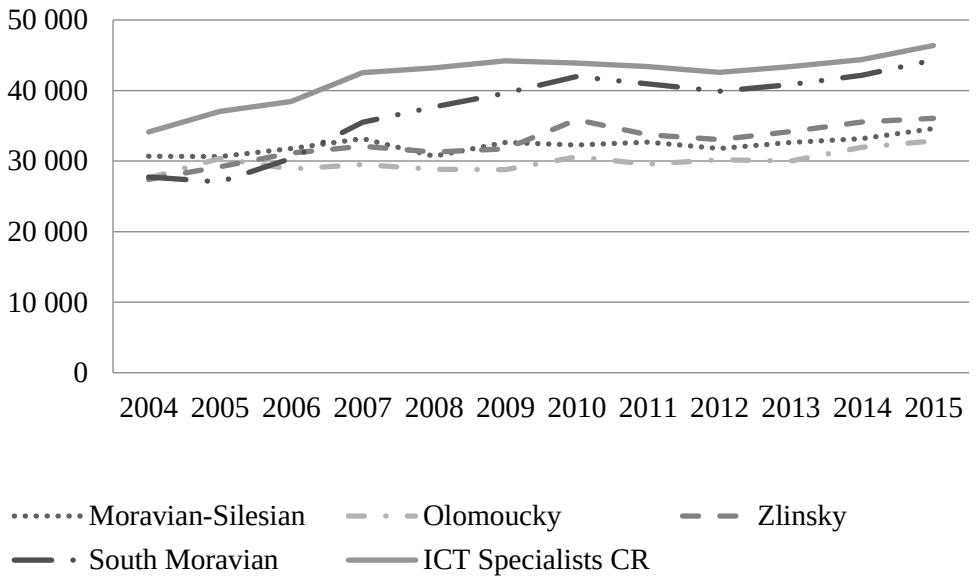
Here presented results represent analysis of real wages recalculated on level of the year 2015. This analysis is realized for four Moravian and Silesian regions (Moravian-Silesian, Olomoucky, Zlinsky and South Moravian) and identified results are compare with average real wage in the Czech Republic in appropriate category.

3.1 Overall Characteristic

3.1.1 ICT Specialists

Real wages of ICT Specialists are presented on Figure 1. General characteristic of wages in investigated period is visible permanent growth.

Figure 1 ICT Specialists Wages, Source: Authors, Data: Trexima



From detail analysis is visible that ICT Specialists have the highest average wages in South Moravian region since 2007. Since 2004 – 2006 were these wages in South Moravian region the lowest between all investigated regions. This region reports

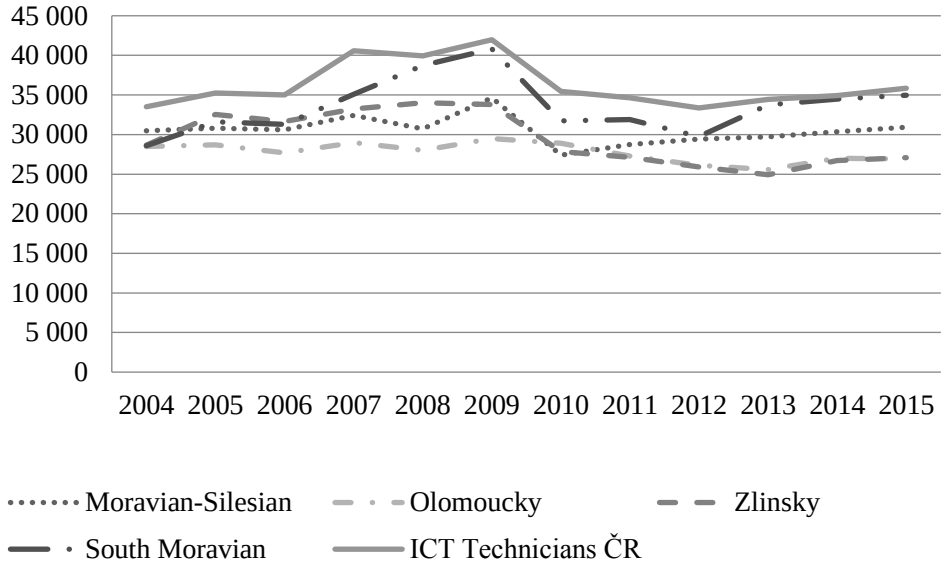
For the whole investigated period are lowest wages in Zlinsky region – the level since 2004 to 2013 rather similar on level of 30.000 CZK. Then is trend a little increasing to 33.000 CZK.

Investigated times series average wages in four Moravian and Silesian regions are below the average of ICT Specialists' wages in the whole Czech Republic.

3.1.2 ICT Technicians

Wages of ICT Technicians show more dramatic evolution then these for ICT Specialists (Figure 2). All investigated period could be split into four sub periods. The first one 2004 – 2006 is represented by relative stabile wages in all regions. Small increase is visible in Zlinsky and South Moravian regions. Starting since 2007 up to 2009 is visible dramatic increase especially in South Moravian region and in average wage of all ICT Technicians in the Czech economy.

Figure 2 ICT Technicians Wages, Source: Authors, Data: Trexima



Small decrease in this period is visible in Moravian - Silesian region in the year 2008 with increase in the year 2009. Main reason for general increase of wages in ICT Technicians and in technical jobs in the whole Czech Republic was caused (CNB, 2016):

- The number of unemployed people in the Czech economic was on local minimum,
- Demand on specialists especially in technical jobs was extremely high,
- Inflation rate was high, in 2008 extremely high,
- World financial crisis did not influence the Czech economic immediately.

Absolute other figure and wages evolution offers the third period since 2010 to 2013. Here, after dramatic drop of wages in 2010 (impact of world financial crisis), follows slow decrease except Moravian – Silesian. In 2012 started to very significantly increase wages of ICT Technicians also in South Moravian region. In 2013 they reached the average level of real wages of ICT Technicians in the Czech economy. Olomoucky and Zlinsky regions report decrease of wages in the whole period. The last fourth period since 2013 to 2015 is represented by slow increase of wages for all regions. The wages are lowest in Olomoucky and Zlinsky regions (approx. 27.000) and real average wage of ICT Technicians in 2015 (Olomoucky – 26.914 CZK, Zlinsky –

27.095CZK) is lower than it was in 2004 (Olomoucky – 28.495 CZK, Zlinsky – 28.674 CZK). Moravian – Silesian region is in the middle of scale with approximately 30.000 CZK in 2015 (it is almost the same values as it was in 2004 – 30.470 CZK and in 2015 – 30.924 CZK). Average wage in the South Moravian region (34.961 CZK) are slightly below the Czech Republic average (35.852 CZK). In generally, it is visible that average wages of ICT Specialists are higher than of ICT Technicians.

3.2 Gender Aspect

New and at this time very often discussed dimension of real wages analysis all over the world and in Moravian and Silesian regions as well is the gender aspect of wages. Following tables show what share of man's wage represents woman's wage in each region during investigated period.

3.2.1 ICT Specialists

For ICT Specialists is this fact presented in Table 2.

Table 2 ICT Specialists – Wage Comparison According to Gender, Source: Authors, Data: Trexima

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Moravian-Silesian	80%	87%	87%	83%	91%	95%	88%	87%	87%	89%	88%	86%
Olomoucky	82%	86%	92%	93%	88%	91%	92%	98%	94%	101%	96%	95%
Zlinsky	84%	85%	--	--	--	--	--	--	91%	--	81%	82%
South Moravian	84%	90%	88%	88%	80%	75%	81%	79%	76%	74%	73%	71%
ICT Specialists CR	77%	82%	79%	79%	78%	78%	83%	82%	82%	81%	82%	80%

Remark to Table 2: There are no data available for Zlinsky region several years

The trend is typical and it shows that female persons do not obtain the same wage for the same work. More detail analysis of these facts in EU countries for ICT Professionals is for example in (Nedomova, Doucek, 2015). This fact is also visible from Table 2 and Table 3. Comments for ICT Specialists is, that the most equality in wages is in Olomoucky region. Long term positive trend has been identified in Moravian Silesian region, where the share of female persons increase for 6 % during investigated period. Negative trend has been recorded in South Moravian region. Data series for Zlinsky region does not offer enough sources for data analysis and after that for appropriate conclusions.

In the whole Czech Republic, evolution of ICT Specialist's wages very slow converges to equality between genders - 3 % in investigated period.

3.2.2 ICT Technicians

The same situation for ICT Technicians is shown in Table 3.

Table 3 ICT Technicians – Wage Comparison According to Gender, Source: Authors, Data: Trexima

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Moravian-Silesian	91%	83%	84%	85%	84%	83%	70%	73%	82%	86%	89%	87%
Olomoucky	82%	95%	89%	88%	96%	96%	82%	88%	84%	82%	87%	88%
Zlinsky	77%	89%	87%	84%	82%	83%	76%	74%	77%	77%	75%	78%
South Moravian	86%	83%	84%	81%	81%	84%	81%	81%	81%	82%	81%	85%
ICT Technicians CR	84%	83%	85%	83%	83%	83%	74%	77%	80%	81%	83%	83%

Different situation has been identified for ICT Technicians. Two regions South Moravian and Zlinsky are on the same level as in 2004. In Zlinsky region is visible increasing equality since 2004 to 2009 – up to 83 % Since 2010 oscillates the rate of equality around 77 and 78 %. For South Moravian region has been identified the equality wage hike in 2015 – to 85 %. The situation in Moravian - Silesian region presents decreasing trend in wages equality. The big jump was in years 2010 and 2011. Since the year is the equality increasing. Only one increase in equality of wages has been identified in Olomoucky region from 82 % in 2004 to 88 % in 2015.

The equality of Wages by ICT Technicians is in the Czech Republic almost the same at begin and at the end of investigated period.

The gap between 2009 and 2010 has been caused by methodology change in job classification. Since 2010 has been applied the CZ ISCO methodology that clearly split ICT jobs to category with mostly university education requirements (CZ ISCO 25) and to category with mostly high school education requirements (IC ISCO 35).

4 Conclusions and Open Issues

The realized analysis brought with it new information about wages in ICT sector. Analyzing the real wages re-calculated on level of the year 2015 we formulated following conclusions:

- ICT Specialists obtain higher wage than ICT Technicians. Main reason is that the ICT Specialists job group requires in majority the university education and the group if ICT Technicians contents jobs with stronger orientation on high school education level.
- The highest wages in group of ICT Specialists has been identified in South Moravian region and the lowest in Olomoucky region (Figure 1).
- The highest wages in group of ICT Technicians has been identified also in South Moravian region. The place for the lowest wages is split between Olomoucky and Zlinsky regions.
- Real wages of ICT Technicians and ICT Specialists are lower in all Moravian regions then real wages of ICT Technicians an ICT Specialists calculated across whole Czech economy.
- Gender aspect of wages in ICT can be concluded as following:
  - Female ICT Specialists obtain from 95 % (Olomoucky region) – 71 % (South Moravian region) of male wage.
  - Female ICT Technicians obtain from 88 % (Olomoucky region) – 78 % (Zlinsky region) of male wage.
  - Trend in equality of wages between female and male is almost constant in investigated period.
  - Comparison of equlity of wages between male/female from all Moravian regions (average value) and male/female calculated across whole economy told us that situation is better in Moravian regions (equality is higher in Moravian regions than in Czech republic). This is valid for both analyzed groups of employees in ICT sector.

Open issue is to realize more detail analysis of real wages in ICT sector and macroeconomic reasons for differences in wages and in equality of wages between:

- regions,
- ICT job groups and
- gender.

Open issue is also analysis of changes in wages between ICT sector and whole economy and find dependency between development in these two groups.

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The Experience in Teaching of Programming at Elementary Schools

Vítězslav Novák[1]

Abstract. Programming at elementary schools is a frequently discussed topic where it is not clearly given when to start and how and in what programming language to program. This article should summarize the teaching possibilities of children's programming and especially describe the experience in teaching of programming at elementary school using the programming language Visual Basic for Application of Microsoft Excel spreadsheet. The programming teaching has been realized within the Program of state support for work with children and youth for non-governmental organizations, grant area Supporting of talented pupils of elementary and secondary schools in 2016

Keywords: teaching, programming, elementary school.

JEL Classification: A20

1 Introduction

Programming at elementary schools is a frequently discussed topic, where it is not clearly given, when to start and how, in what programming language to program and whether to use traditional programming languages. This article should summarize the teaching possibilities of children's programming and especially describe the experience in teaching of programming at elementary school using the programming language Visual Basic for Application of Microsoft Excel spreadsheet. The programming teaching has been realized within the Program of state support for work with children and youth for non-governmental organizations, grant area Supporting of talented pupils of elementary and secondary schools in 2016 at elementary school at Valašské Meziříčí during the afternoon lessons for children from classes 7 to 9. Lessons were attended by 15 children. This lesson was held ten times every 14 days and lasted 3 teaching hours. Thus, the total subsidy was 30 teaching hours. The project implementer was VŠB-TU Ostrava, Innovation Support Centre.

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2 Teaching possibilities of children's programming

The topic of teaching of programming for children is quite interesting, but also difficult, because there is no guidance on how to proceed, what programming language to choose, whether structured or object-oriented, or even whether to choose a classic programming language or better visual programming language.

Anyone who wants to teach children programming has two options in principle:

- visual programming language,
- classic programming language.

2.1 Visual programming language

The disadvantage of using conventional programming languages such as Java or JavaScript for teaching of children's programming may seem the necessity to teach children the basics of syntax of the programming languages instead of immediately accede programming of application logic and children seeing the result of their work as soon as possible. This necessity is eliminated if you use any of the visual programming languages. According to Lučanič and Fabka (2011) the aim of the visual programming languages is to move a part of the programmers work to IDE, so that the programmer can concentrate more on the logics of the algorithm than on the syntax of programming language itself.

We have two types of environments for teaching of children's programming in visual form:

- **environments of a puzzle type** (Scratch (https://scratch.mit.edu/), Snap (http://snap.berkeley.edu/), Code (https://code.org/), Programování pro děti (http://programovaniprodeti.cz/) etc.),
- **environments for creation of games** (Kodu Game Lab (http://www.kodugamelab.com/), Project Spark (http://welcome.projectspark.com/) etc.).

Environments of a puzzle type

Environment of a puzzle type is a visual programming language that enables you to create programs by manipulation of graphical programmatic elements and not in text form. These elements are similar to the jigsaw puzzle

type, where according to the shape of the element you can determine which command can be placed together and which not. The basic principle of these environments is to enter commands for the default character (e.g. in the case of Scratch it is the cat). Gradually you can get from simply running around the empty box to the first conditions, dialogues or variable.

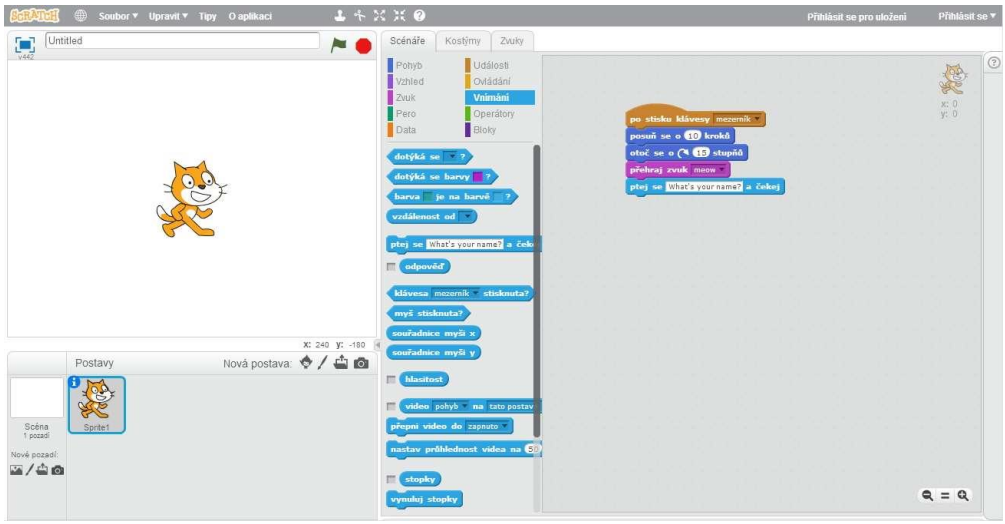

Figure 1 Environment of Scratch, Source: own

The principle of using these environments suggests that these environments are useful for learning algorithms, not for creating complex programs or games.

All environments mentioned above are possible to use online and are usually localized to the Czech language.

Environments for creation of games

Environment for the creation of games are also a visual programming language made specifically for creating games. The basis of these environments is a game engine where the programmer can complete by a visual form both the game environment and program reactions to various events of selected objects, all based on the principle WHEN - DO, the statement similar to IF - THEN available in almost all programming languages. Because of the complexity these environments are not available online, but must be installed.

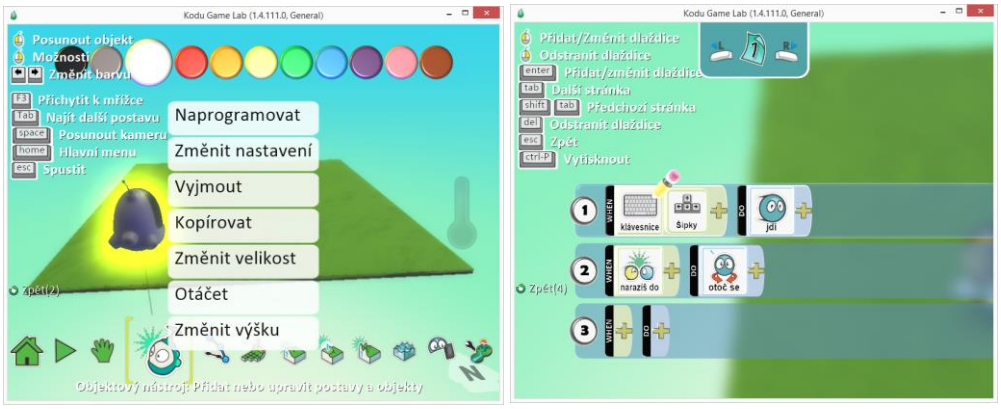

Figure 2 Environment of Kodu Game Lab, Source: own

2.2 Classic programming language

If the aim of teaching programming was to teach children algorithms, therefore, to teach them to formulate the problem, to divide it into individual elementary steps, to build these steps up the final program and to start it, then visual programming languages are certainly an illustrative, a relatively simple and, moreover, a funny way how to teach it children. But the question is, was it the aim? So to learn to build a program from individual commands, but with the help of very narrowly focused and very simplistic instruments? But if the children should learn some more universal instrument how to write an algorithm, it is necessary to use one of the classic programming languages.

Even in the area of classic programming languages the choice is very wide and therefore too complicated. It is necessary to consider many often contradictory characteristics, e.g.:

- structured language x object-oriented language,
- strongly typed languages x weakly typed languages,
- language with IDE demanding on system resources x language with IDE not demanding on system resources etc.

3 The using of Visual Basic for Applications for teaching programming at elementary schools

After considering all the pros and cons the programming language Visual Basic for Applications was chosen in elementary school in Valašské Meziříčí for teaching of programming for the following reasons:

- it is a relatively simple language, and although it is not object-oriented, it supports working with objects, pupils then realize what is the object, that it has some properties and methods and they learn how to manipulate them,
- it is a weakly typed language, so children, at least initially, do not necessarily think about data types, but they can only focus on the individual programming algorithms (nevertheless, explicit variable declarations are recommended),
- No special IDE is necessary to install for VBA, it is enough to install Microsoft Office of any version, which is now an absolute standard, and where in VBA you can program above any application of this package. These applications are also not demanding on the system resources of the computer, which can suite the particular schools that are not equipped with powerful hardware.

After choosing a programming language it was still necessary to consider how to teach programming. After the first run of programming I would suggest the following principles:

- **Minimum of theory** - the taught theory must be reduced to a minimum, really teach only what is necessary and every single new thing immediately check on some simple little programs, the best a game. Enough knowledge for pupils in their programming were basic data types, the principle of using procedures and functions (including several functions such as VBA MsgBox or InputBox), the principle of using controls of forms, their properties and events, basic control commands such as loop or conditional statement and an error handling. Theory is simply boring for children.
- **Used MS Office application is not important** - although the VBA environment was used in Excel, the Excel and its object model was practically not used, at the most to enter the input values of running programs. Pupils at elementary schools are still not interested in Excel, they are not able to appreciate its significance. For this reason, the application particularly of Excel has no fundamental importance, with the same result it would be possible also to use Word or PowerPoint.
- **Programming of games** - nothing attracts more attention of pupils than to program a game and it could be game more than simple, like the card game Oko using one cell and two buttons (see picture below). Maybe

Comenius "playful school" is applied here perhaps more than anywhere else. For pupils it is much more enjoyable and thus more interesting when the game is not played in the Excel environment or with the output on the console, but in form environment. Proof of this is that all voluntary homework was created in form environment. You can create in forms simple applications like control cars by keyboard arrows and even with the passage through the particular walls etc., see figure below.

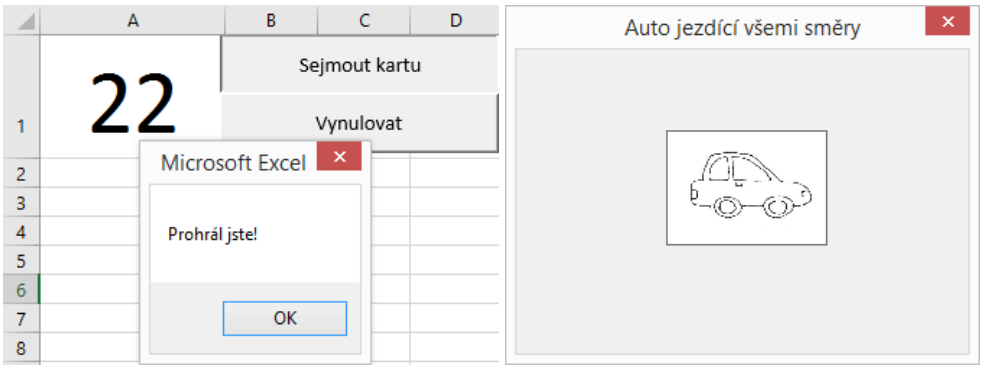

Figure 3 Games Oko and Car, Source: own

- **Let something happen by itself** – nevertheless it is much more interesting for pupils when something goes automatically in the game window. While VBA does not support multi-threaded programming, this handicap can be easily circumvented e.g. by following procedure that suspends the running of performed procedures without stopping responding to other application events:

```
Sub Wait(Seconds As Single)
    Dim EndOfPause As Single
    EndOfPause = Timer + Seconds

    Do While Timer < EndOfPause
        DoEvents
    Loop
End Sub
```

This can be used e.g. for designing applications such as stopwatch or table tennis, see figure below.

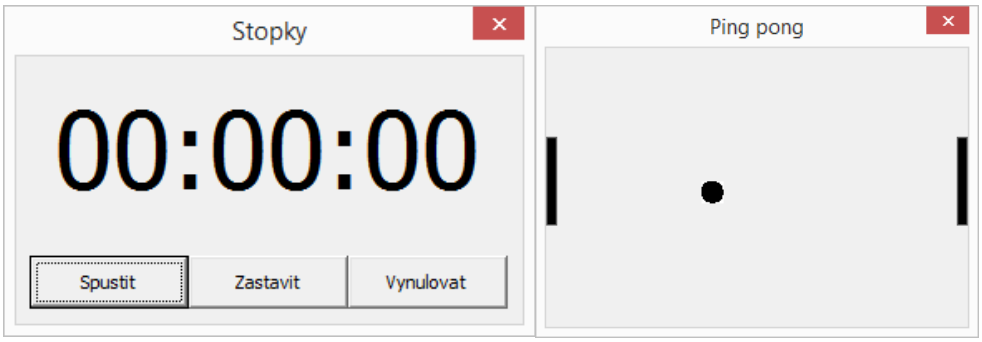

Figure 4 Games Stopwatch and Table tennis, Source: own

4 Conclusion

After the first set of lessons of introduction to programming in VBA in a elementary school in Valašské Meziříčí I dare to say that the method of teaching, it means VBA programming language taught by the principle of "playful school" was chosen correctly. A proof of this can be almost 100% attendance of pupils in lessons, but also the programs that some pupils voluntarily created as an output, see the following figures:

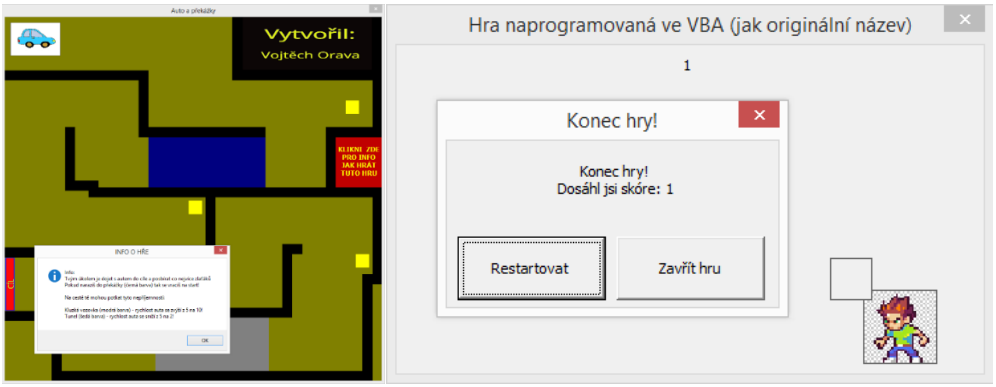

Figure 5 Examples of individual works of students, Source: own

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Features of MOOC Project in the University

Larysa Nozdrina[1]

Abstract. The article presents a number of problems, determining the current state of development of the domestic market of massive open online courses (MOOC). Considering the aim of the research, there is described national experience in this area, proposed and substantiated a number of the criteria and features of MOOC project in the university. The development and implementation of MOOC project in the Lviv University of Trade and Economics (LUTE) in the platform MOODLE is reviewed as example. Experience of MOOC project in LUTE can be useful when creating similar courses at other universities in the different platforms, both MOODLE, and on the others.

Keywords: LLL, educational innovation, MOOC, project, life cycle, software, lecture videos.

JEL Classification: I 23, O31, O32, M15

1 Introduction

The concept of lifelong learning (LLL) is a response to challenges of fast changing world, which can ensure meeting the cognitive needs of all interested persons. Nowadays a revolutionary innovation in the market of educational services, which realizes this concept, is massive open online courses, MOOC, which make it possible to grant online access and openness of learning for people from different social groups without limitations by social status, age and place of residence.

2 Research questions and objectives

More than 100 of world's best universities, including Cambridge and Oxford Universities, realize MOOC projects (the largest registered audience equaled to 1 million users). In particular, Minerva Project was realized in the USA, what made it possible to create an innovative university without own lectures, students of which only have to take a MOOC, and their knowledge is later assessed during seminars. This project is now a candidate to US TOP-10 universities (Walker, 2014).

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In Ukraine MOOC started only 3 years ago. In particular, this is a MOOCology project – an educational platform, founded in April 2014, based on the concept of "blended learning". Online courses of world's best universities are adapted by MOOCology team for Ukrainian audience (MOOCology, 2014).

The next one is a civic project Prometheus, which appeared in October 2014, and it (in the contrary to MOOCology) provides MOOC free of charge. The project consists of programs of study of best Ukrainian universities and it has engaged 200 thousand registered users. Structure of courses is classical for a MOOC platform - video-lectures, interactive tests, discussions of issues at online forums (Prometheus, 2014).

Due to its short history, MOOC require fundamental study, what is now realized by M. and B. Gates, N. Hydvany, D. Coller, G. Siemens, D. Cormier, S. Turn, S. Downs, S. Han and others. Among Ukrainian scientists, studying MOOC: K. Buhaichuk, V. Kukharenko, A. Dlihach and founders of the «Prometheus» project: I. Prymachenko and O. Molchanovskyi.

3 Results of the study

My personal educational experience within the Prometheus project supposes the following conclusions: material is interesting and well-structured; instructors are professional; there is an interaction between instructors and students; tests make it possible to assess obtained knowledge.

3.1 Criteria for introduction MOOC in university

Studying global and Ukrainian experience of creation and education in MOOC made it possible to develop criteria for introduction own massive open online courses in universities. In particular, Delft Technical University from the Netherlands offers such criteria for MOOC development (TuDelft, 2014):

1. Reliable:

a) the content of the MOOC should represent rigorous academic standards and be based on an existing accredited course of the university or on a current outstanding research project / program,
b) the responsible instructor is an internationally recognized expert in the subject of the course.

2. Understandable:

   a) the content of the MOOC is conveyed in a clear and efficient manner, implementing online learning theory,
   b) instructors appreciate the specifics of online teaching and implement the best practices in the MOOC,
   c) the detailed course design: learning objectives, videos, (interactive) assignments, forum activities, learning activities and assessment.

3. Inspiring:

   a) students have many reasons to enroll in a MOOC and obtaining a certificate is just one of them,
   b) the instructors are enthusiastic about teaching the MOOC, able to convey their passion for the field and subjects they teach,
   c) the course uses methods to enhance interaction and activated learning,
   a) the course materials are challenging and presented in an inspiring way.

4. Recognizable:

   a) the MOOC is appealing to a broad audience (master or bachelor programs or courses),
   b) an outstanding reputation of the university in the topic of the MOOC,
   c) attracting the best students, research and faculty staff,
   d) links with business and governmental bodies,
   e) the communication plan includes the strategy to attract a large number of students, and takes into account that the number of MOOC offered on different platforms is growing.

5. Innovative:

   a) the MOOC is innovative and may be used for research to improve both online and campus education.
   b) MOOCs offer a great opportunity to experiment and test educational innovations,
   c) the results will be used for research to do a-b testing, improve online didactics, new virtualization techniques, online exercises, and to use social media to enhance active learning,
   d) there is a plan on how to assess the results and use the data that will be generated by the MOOC.

We might agree with these criteria and further emphasize, that a high quality MOOC – is first of all a high quality content, for creation of which the personality of course's author, as an initiator and an enthusiast, his ability to convey difficult topics in a simple manner implementing up-to-date platforms, video- and audio-materials, and the presence of some organizational structure with strict deadlines, play a crucial role (Nozdrina, 2016).

3.2 Experience in developing MOOC project in LUTE

So, considering the above-mentioned criteria, the first MOOC was realized in Lviv University of Trade and Economics (LUTE) in spring 2015, called "Presenting master's thesis results: Prezi and elements of rhetoric", developed for a broad audience: students, teaching staff and all interested (Figure 1) (LUTE Web-center, 2015).

3.3 Key factors for successful MOOC project

The main factors that were put under the research and determined the success such educational innovation as MOOC project in LUTE were platform, multimedia software to create video lectures, course structure and support the learning process. Although the "Prometheus" project was created on the EDX−platform, specialists of LUTE selected the MOODLE (Modular Object-Oriented Dynamic Learning Environment) platform for realization, because they had earlier developed the Web-center for ensuring e-learning on the MOODLE (Nozdrina, 2016).

3.4 Life cycle MOOC project

The life cycle of this MOOC project was in accordance with the standards of IT-projects and consisted of stages of requirements analysis, design, development, implementation and evaluation (Nozdrina, Melnyk, 2013). The process of course creation consisted of such basic steps (Nozdrina, 2016):

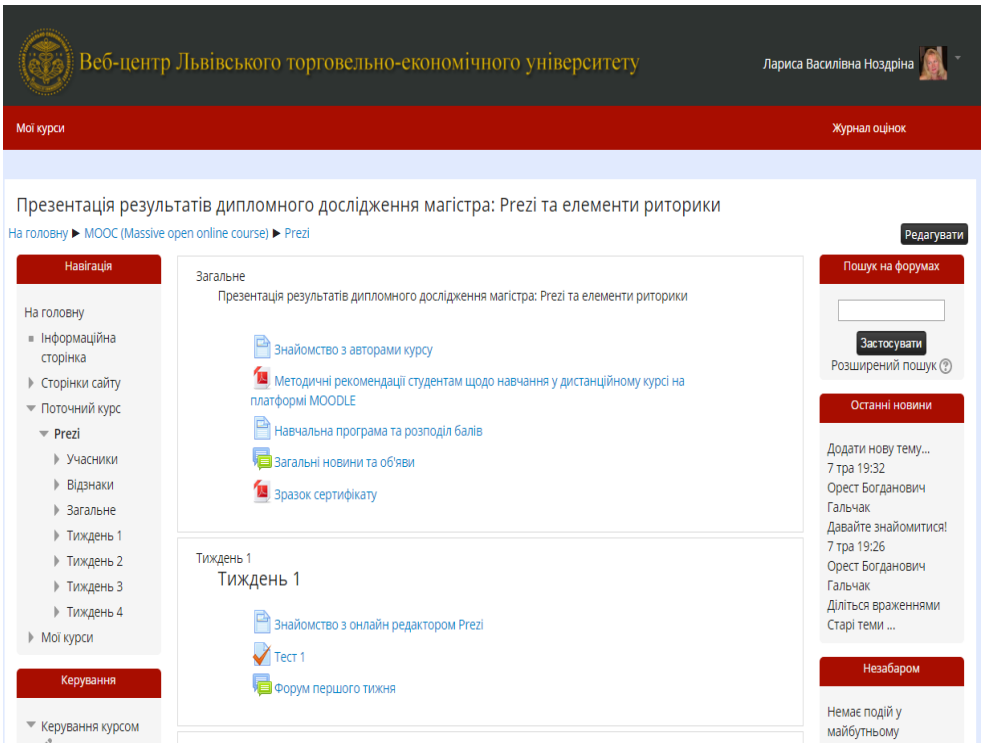

Figure 1 Fragment of the MOOC structure Source: LUTE Web-centre, 2016.

1. At the stage of analysis:
    a) selection of the platform,
    b) selection of the course and its standards,
    c) determination of the author and the tutor.
2. At the stage of course design:
    a) selection of course format,
    b) creation of course structure,
    c) creation of content and tests?
    d) development of an assessment scale,
    e) determination of deadlines.
3. At the stage of development:
    a) creation of video lectures, tests and other educational e-materials,
    b) filling with content.
4. At the stage of implementation:

a) support of educational process.

5. At the stage of evaluation:

a) analysis of learning outcomes.

We will describe the design of the course "Presenting master's thesis results: Prezi and elements of rhetoric" in details. The total length of the course is 4 weeks, first 3 weeks are dedicated to the Prezi service (used for creation of the presentation material), and the last week is dedicated to the elements of rhetoric (for the successful defense of a thesis).

3.5 Creation of video lectures (software and project activities)

The most difficult task at the stage of development was to create video lectures for the MOOC. First, authors created scenarios in text format (there were 5 lecture texts, including a zero week), then they selected video recording software (Table 1).

Table 1 Process of video lectures creation, Source: own, 2016.

N	Software	The content of project activity
1	Photoshop CS6	Editing bitmaps
2	After Effects CC	Edit video and moving images, the development of compositions
3	Media Encoder	Encoding of video materials
4	WebCamMax	Working with webcam
5	Camtasia Studio 8	Montage of video
6	YouTube	Placement of video materials

The length of video lectures, like in the "Prometheus" project, was 10-15 minutes each, except the zero week (up to 1,5 minutes), because the introductory format does not require much time. The specifics of the course was also taken into account, so first 3 video lectures were designed at a step by step regime and recommended to be learned together with the author. Besides video lectures, tests and forums for each week were developed.

3.6 Result of implementation

Totally (as of June 13, 2015) 54 persons had been registered for the course – teachers and masters from LUTE from departments of "Economic cybernetics", "Management of innovative activities", "Economics of enterprise", "Organizational management". Among motivational mechanisms for learning: interest to the Prezi service, obtaining certificate from a branch of the UNESCO chair "New information technologies in education for all". Only 9% of all registered students completed an individual assignment and obtained certificates, what corresponds with the global learning trends in MOOCs (Nozdrina, 2016).

4 Conclusion

Popularity of MOOC attracted attention of universities from all over the world, seeking ways to increase their competitiveness in the market of education. Today MOOCs are becoming more and more popular among all people, who want to learn and improve their earlier acquired knowledge. Joining other Ukrainian MOOC projects, LUTE developed its own open online course "Presenting master's thesis results: Prezi and elements of rhetoric". The results of the study suggest the following conclusions:

- realization of a MOOC project is a complicated process and requires much time and qualified human resources,
- on average creation of a video-lecture takes 1 week, and creation of templates for video takes 1 month, for creation of video-lectures one should use a lot of software programs (in our case – 6), usage of which requires appropriate qualifications,
- criteria for realization of MOOC projects include not only high quality content, but also an organizational structure and an inspiring component,

- the life cycle of these projects is similar to IT-projects, but it is characterized by an intensified stage of evaluation and the use of instruments of electronic pedagogics, MOOC web-site automatically gathers learning information, what makes it possible to immediately introduce changes to course materials and assess their learning effects in real time,
- projects provide integration of MOOC with the campus learning in the form of «blended learning» – combination of online and offline education.

The results obtained showed, that MOOC projects in universities is an innovation, found attractive by students, although there might be problems with their motivation, Experience of Ukrainian projects, and LUTE project in particular, confirms this conclusion. Further research should focus on the development of institutional mechanisms to ensure the effective design, implementation and operation of the MOOC projects in the universities in Ukraine. Particular attention during learning in MMOC should be aimed at improving the educational process and to strengthening student's motivation.

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International Remittances and New Technologies

Martin Pochyla[1]

Abstract. Information and communications technology (ICT) has been one of the main reasons of growth in many developing countries, particularly due to its ability to support trade, capital flows, communications and mobile transfer services in new directions. Remittances are another interesting source of growth in developing and emerging economies. This paper main goal is the focus on new models of interaction and technology used for sending and receiving international remittances. Secure, fast and affordable flow of remittances is crucial to empowering working families and expanding financial access. Modern ICT and approaches like mobile payments and cryptocurrencies are opening totally new opportunities in the world of remittances.

Keywords: remittance, Bitcoin, cryptocurrency, smart contract, blockchain, e-wallet.

JEL Classification: E24, E42, L86, O33, J61, J15

1 Introduction

Nowadays millions of people live and work away from home following economic opportunities and sending part of their earnings home to their families - remittances. For people within the same financial jurisdiction, this is relatively simple. Other millions need to transfer the funds long distances and across national boundaries. They must be aware of mobile payments security, international criminal regulations or currency conversions. Problem of the remittance is how to enable person-to-person, small payments, with minimal overhead and cost, anywhere in the world as McGrath (2015) pointed.

Remittances are generally defined as the sum of the following three components. Each can involve both credit (inflow) and debit (outflow) items in the balance of payments

a) Workers Remittances - current transfers of funds by migrants who are residents to individuals, such as family members, in another country.

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b) Compensation of employees - wages and salaries for work in countries other than where they are.
c) Migrant transfers - net worth of individuals transferred when they become residents of another country.

According to Murphy (2015) the most remittances are still sent in cash informally or via risky high-street agents. In 2016, international remittances are expected to rise. Over 250 million migrants worldwide send money home, making the global remittance industry worth more than $600 billion US dollars a year.

Mobile remittances have a high development potential as they hold the promise of providing quick, easy and cheap money transfers. In East Asia and Africa, mobile phone usage has increased sharply and mobile banking providers are extending their services. Faster rise of mobile banking and new forms of money delivery, however, differs substantially across countries, mainly due to a lack of financial or technological infrastructure like cloud computing (Tvrdíková and Koubek, 2011).

The size of remittance market and the fact that it is still dominated by companies like Western Union together with payment behaviors make it ripe for disruption and has attracted many new contenders. The extraordinary amounts of venture capital being poured into the money transfer industry, over $140m in the first two months of 2015 alone, are enabling new technologies and business models to take over as stated by Oberholzer (2015).

Restrictive financial regulations play a key role as well. Mobile remittances have the potential to become an important and revolutionary tool for remittance sending in Africa, Latin America and East Asia. Effective policies should therefore address the limitations in the regulatory and financial infrastructure for mobile banking to become the foundation for mobile remittances.

2 New technology and models of interaction

International remittances are a life-critical form of cash transfer to tens of millions of families and communities around the world and use of technologies like mobile phone, internet or cryptocurrency offer a very significant opportunity to improve this. There is a wide range of techniques for effecting remittance payments emerging. These also have substantial implications for

business models of participating institutions, including potential for cooperative agreements between various types of participants, and for public policy. A few of these techniques are discussed below to explain the direction of potential developments.

As Figure 1 shows, new devices, sources and access channels creates together new forms of interactions. Generally, new solutions are built for contactless and remote behaviour.

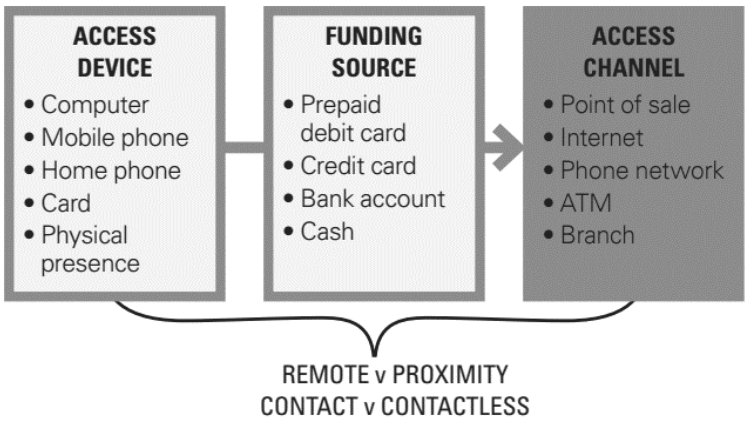

Figure 1 Devices, funding sources and access channels, Source: Davis, 2016.

New technology change in payments impacts remittances in a number of different ways:

- Sophistication of remittance technology solutions – Bringing lower set up cost, broader network of outlets, re-usable core payments functionality, Assembly – Distribution – Manufacturing out of the box for a range of customers.
- Sophistication of remittance consumer products – Increasingly convenient access, smart technology supporting the remitter and the remittee with accounts and information, confidence, speed and security.
- Banks can invigorate remittances business – Extending existing capabilities or adding remittances to the business case for technology investment, creating linkage between remittance and other electronic payments channels and consumer products.

Financial institutions continue to be aware of the opportunity from servicing all potential clients in new emerging markets, and are investing in a

broad set of technology to enable all market segments as described by Rozehnal (2013).

Figure 2 shows three main areas which are affected by new approaches and technologies.

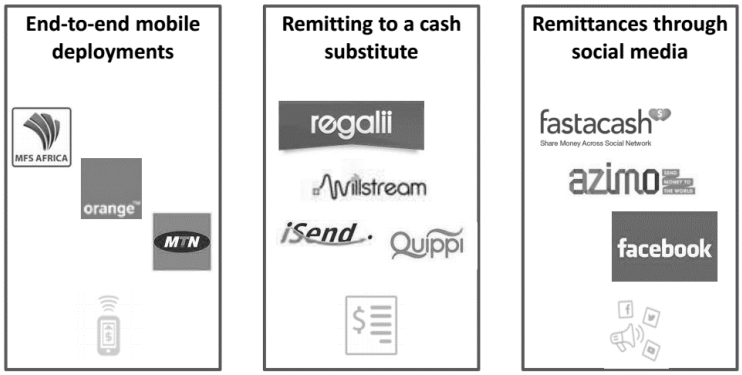

Figure 2 Modern remittances channels, Source: Macharia, 2014.

First group represent solutions based on mobile infrastructures and mobile wallets. One of the success stories in innovations in domestic remittances is M-Pesa in Kenya, which draws on the widespread use of mobile phones and agents associated with the network provider. Essentially the process involves individuals transferring phone credit from their account to the account of another individual by way of an SMS message. The recipient can then convert that credit into cash through one of the many agents of the phone company, or via traders who act as intermediaries buying credit for cash. This system has advantages of low cost and minimal customer identification requirements. It requires the widespread use of a common mobile phone network, or cooperation between network providers, and infrastructure, to enable credit on one system to be converted into credit on another. In the case of international remittances, where there are different national providers of mobile phone networks and foreign exchange currency conversion considerations involved, there are significant impediments to the growth of this remittance technique.

Second group represent companies and technologies based on cryptocurrencies or prepaid cards. The leader of the cryptocurrency world is Bitcoin and main pros and cons are discussed below. Last group is very new and promise to arrange remittance send through social media. Nowadays there

is at least eight main players[1] which prepare or build money transferring system based on social networks. According to Ráček et al (2013) social media and networks can be very useful for building users profile for offering new services.

Example of the cooperation between legacy world and startups is Visa Europe Collab. Visa has been working with Epiphyte, a startup specializing in distributed ledger solutions for the mainstream financial market, to see if blockchain technology might hold the key to improving international remittances as stated by Harrison (2016). As the result of such as cooperation Visa created new product mVisa. According to (Buntinx, 2016) mVisa will let anyone access and use funds regardless of which mobile provider they are on. In-store payments can be completed by scanning QR codes with a smartphone. Owners of a feature phone can enter the merchant's phone number to complete the transfer. So far, mVisa launched in India last year, where it is being used by roughly 30,000 merchants. The company will expand their presence in Africa over the coming years, targeting regions such as Uganda, Rwanda, and Nigeria by the end of 2016. For now, it remains to be seen how much competition this will bring to M-Pesa and Bitpesa in Kenya as a leader of adoption of modern technologies in Africa.

The Philippines, 3rd largest remittance market after China and India, could also lead the way in the digital currency with Coins.ph as Filipinos are heavy users of mobile phones. And to make these mobile wallets work in point of sales, more startups offering payment gateways have popped up such as Kopo Kopo in Kenya or ToneTag in India.

Remittance prices and price aggregators

The single most important factor leading to high remittance prices is a lack of transparency in the market. It is difficult for consumers to compare prices because there are several variables that make up remittance prices together with new technologies and small financial education. Because of the new aggregators prices can be more transparent and comparable.

According to Oak (2015) the global average cost of sending small amount of money ($100-$200) declined from 8% in Q4 2014 to 7.7% of the

[1] Source: http://i0.wp.com/fintechranking.com/wp-content/uploads/2015/10/MESSENGER_TABLE-011.png

amount transferred in Q1 2015. Yet the average cost of remittances still exceeds 8% in East Asia and the Pacific. In Sub-Saharan Africa, the home of mobile money, costs of sending money across borders remains the highest. Sending money from South Africa to Zambia, Malawi, Botswana and Mozambique are the highest in the region. With the global average cost for sending money standing at 8% in Q4 2014, it is substantially higher at an estimated 12% in Sub-Saharan Africa.

One of the biggest services is Monito a comparison website for international money transfer services. They compare and review more than 450 money transfer operators, to help users find the best option for each of their international transaction.

Very interesting is project founded by the World Bank. Their database cover Remittance Prices Worldwide[1] for 365 “country corridors". The corridors include 48 remittance sending countries and 105 receiving countries. In case of the Czech Republic we can find calculations for Ukraine and Vietnam. Average cost for sending money is around 9% for both countries.

3 Cryptocurrency and blockchain world

Cryptocurrency has technical properties well designed for money transfers. It is a person-to-person transfer, which costs very little to execute. The protocol is secured by cryptography and the decentralized consensus process, and anyone on the Internet can use it. Cryptocurrency such as well-known Bitcoin can be transferred from a computer in one country to a computer in another country, nearly instantly, and at a tiny cost. Furthermore, since the transfer does not pass through financial institutions, it avoids fees, paper work, and political interference. Even better, cryptocurrency works just as well for small transfers as large, and the equipment and software are readily available everywhere.

Bitcoin has recently become quite a debatable topic as the opinions are diverse when it comes to the question of whether bitcoin use in terms of security and other risks related to cryptocurrency. There are even some compelling reasons why bitcoin may be dead soon. Despite warning signs, global banks are actively getting into the race of developing their own digital

[1] Source: https://remittanceprices.worldbank.org/en/countrycorridors

cash. According to Kate (2016) there are activities in the remittance space, and it is particularly interesting that bitcoin has a great potential in the segment with at least 19 bitcoin-powered companies fueling bitcoin remittance around the world. One of the biggest startups is BitPesa in Kenya which has entered the remittance market and solved an important issue for the African diaspora around the world. Kenya is also home to the most advanced mobile money market in the world with the M-Pesa mentioned above.

On the other side according to the Rebit.ph co-founder (Wirdum, 2015), bitcoin doesn't really enable cheaper remittance from a customers' point of view. This is because nearly all of the costs made by remittance companies are in "the first and last miles" of the process. In particular, it's converting digital money into physical cash, and distributing this cash to the different end-points to be picked up locally, that bears most of the cost. It makes little difference whether the funds made it there as digital dollars or as digital bitcoin.

Bitcoin transaction is not free and there are fees associated with Bitcoin. Customer has to pay to acquire bitcoins in the first place. Coinbase, the largest Bitcoin wallet service, charges 1% for each transfer from bitcoin to dollars or from dollars to bitcoin + a flat fee of $0.15. Bitcoin has a total value of $10.8 billion, which is little compared to the total stock of the U.S. dollar and the $4 trillion in global currency traded daily. Merchants haven't adopted Bitcoin widely because the price is volatile and because governments haven't decided how to regulate it yet as stated by Cruz (2015).

According to Norton (2016) a blockchain is a data structure that makes it possible to create a digital ledger of transactions and share it among a distributed network of computers. It uses cryptography to allow each participant on the network to manipulate the ledger in a secure way without the need for a central authority.

Next to the use of blockchain technology for fast, low-cost processing of payments can be used so called smart contrast. By using smart contracts payments can be made conditional. The world of cryptocurrencies lends itself very well to smart contracts. Cryptocurrencies are programmable currencies. Bitcoin, for instance, utilizes a simple scripting language - transactions actually run as scripts. Platform can be programmed with conditions for a transaction to execute automatically, instantly, and most importantly without the middle agency of a human being as stated by Meijer (2016).

Blockchain technology is finally transitioning from experiment to usability concept in the payments world. There are a number of base blockchain platforms that are important in the payments area. One of the big players are Ripple and Ethereum. Ripple's solution is built around a decentralized network that offers a cryptographically secure end-to-end payment flow with instant transaction verification. Ethereum has created an alternative protocol for building decentralized applications. Ethereum has a blockchain protocol with a so-called Turing built-in programming language, allowing anyone to write smart contracts and decentralized applications.

4 Conclusion

The weakest individuals and families around have very little access to good financial tools. Cryptocurrencies generally open up a new world of fast and affordable international remittances and payments. It is not necessary for any user to even have a bank account. Bitcoin and cryptocurrencies are incapable of providing support to remittance exchanges unless it can integrate with the way how people live, and with the tools that people are familiar with. Otherwise we need to re-educate people and companies have to get the whole world to adopt to some entirely new standards. As a little point of interest, the micro-remittance market ($20 and less) has been poorly addressed by the giants of the industry. In my opinion much potential could lie here.

As for the banks and money service businesses, not maintaining individual accounts for every customer can save millions on compliance costs on their site. Significant progress has been made and the cost of sending remittances has indeed fallen considerably as well. Nowadays, the average global cost is 7.68 percent. According to estimates, the cost reduction has saved migrants and their families more than $60 billion as stated by Grandolini (2015).

There are still, challenges abound to make the remittance business more digital and user-friendly. Remittance senders will have a higher learning curve when it comes to cryptocurrency because they are generally underconnected, underbanked, and wary of online financial services. Mobile money and other technology-enabled remittance deployments are promising, yet their ability to dramatically change the sector is still to be determined. World of international remittances is still waiting for final killer application of Bitcoin or blockchain.

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IT INNOVATION IN ENTERPRISES

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Selected Areas of Computer Supported Organizational Creativity

Kamila Bartuś[1], Tomasz Bartuś[2]

Abstract. The authors of the article introduce the issues of competence in terms of organizational creativity. They describe the study which has resulted in building a system to support organizational creativity in the field of exploring, identifying, and creating a portfolio of competences. The results obtained may be helpful in designing computer systems to develop the portfolio of competences in terms of computer (IT) supported organizational creativity.

Keywords: organizational creativity, competences, computer system to develop a portfolio of competences.

JEL Classification: D23

1 Introduction

As it has been rightly remarked, (Olszak, Kisielnicki, 2016) organizational creativity is considered one of the most actively developing research areas. It is asserted that it is a main vehicle of organizational development, the basis for staying in the market and innovative success (Amabile, 1988; Elsbach & Hargadon, 2006; McLean, 2009; Shin & Zhou, 2007). Moreover, research that has been carried out for many years still lacks studies on complex IT-based organizational creativity support. The research focuses mainly on creative problem solving, creative processes, and systems supporting individual creativity. (Cooper, 2000; Dewett, 2003).

2 Characteristics of competences and their role and place in organizational creativity

For an enterprise operating in a dynamic environment, the fast adaptability and continuity of operations are becoming increasingly important. The volatile enterprise setting may lead to attempts at creating, connecting and reconfiguring resources as its disposal, in order to create new value. Such the approach can stimulate the desired activity in business models of the

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enterprise, customer service, products and services. This overall framework overlaps with a theory of organizational creativity.

According to numerous researchers (Gong, Haung & Farh, 2009; Klijn & Tomic, 2010; Choi, Madjar & Yun, 2010; Zhou & Ren, 2012) organizational creativity is associated with generating new and useful ideas that involve many areas of the enterprise, such as products, services, processes, corporate governance, business models as well as competitive strategies.

In the area of organizational creativity it is worth noting the important role of the two components. The former is the people / employees, especially their unique skills and competences providing the opportunity to develop their accomplishments. The latter, in turn, involves information and unrestricted access to it (Olszak, Bartuś, 2013; Olszak, Bartuś, 2015). Bearing this in mind, we can argue that initiating organizational creativity can be achieved by a strategy of developing competences of employees and satisfying consistently the need to acquire information on many levels of the organization.

Reviewing the subject-matter literature, many interesting definitions of competence can be found. The careful analysis of definitions shows that they are consistent, at least in one area, because competences contribute significantly to the development of competitive edge of any enterprise (Rakowska, 2008). Most often the competences are understood as assets, skills, or resources belonging to the enterprise which enable the enterprise to carry out operations by the appropriate use and combination of resources. (Sitko-Lutek, 2007).

One of the authors describing the skills of organizations that make up the competence states that the assets alone may turn out to be worthless "without the organizational skills and their mobilization and exploitation in such a manner that added value for customers can be created." In his opinion, it is the key skill that reflects best the strategic skills of any organization. (Obłój, 2001).

From the point of view of organizational creativity, it is important that identifying competences and using them to develop the portfolio of competences allow the organization to select and match the particular competences required to a particular work position and/or employee. This portfolio should contain a set of competences necessary to achieve fully satisfactory or exemplary results at the specific position, team, unit,

department, or organization (Dubois, Rothwell, 2008) and, consequently, in organizational creativity.

The question remains as to how to acquire competences required by organizational creativity. The subject-matter literature specifies different manners to achieve this goal. For instance, one of authors provides five manners to acquire specific competences for the needs of an organization. They include (Malara, 2006):

- learning and studying: learning, self-study, new knowledge resources, new theories and research results;
- learning from the competition: tracing, monitoring, public relations, benchmarking, sponsoring, franchising;
- exploiting knowledge from the business setting: consultancies, business schools, the media, conferences and symposia; learning through the exchange of dialogue, discussions, negotiations, interviews, communication;
- learning through experience and systematic problem solving.

It is worth noting that organizational creativity is not indifferent in terms of competences. It is quite the contrary; it requires the continuous development of competences possessed and the active identification, exploration, and acquisition of new ones. Competences are dynamic and, therefore, they have to evolve repeatedly to the needs of organizational creativity. This is due to the fact that competences change over time, they may become out-of-date and, instead of them, it will be necessary to acquire new skills. Therefore, it is a repeated and difficult challenge for any management to develop and update the set of unique skills and resources, including information resources that can be a source for organizational creativity.

3 Exploration, identification, collection, and analysis of competences useful in organizational creativity

This study initiates an attempt at developing functionality of computer systems for organizational creativity support. Based on the results, its practical implementation has been undertaken.

For this purpose, a research experiment has been conducted involving the development of a model of selected functionalities of a computer system, which task is to support organizational creativity in the field of exploration, identification, and development of competences for organizational creativity.

It should be emphasized that the manner proposed to find and identify competences according to the needs of organizational creativity is not the only solution in this area. In large part, this is supposed to support significantly the organization in the fast and ad hoc elimination of the competence gap, i.e. a situation in which the organization lacks the competence to carry out specific operations. This is only a proposal of tools, and organizations may use them as a compass indicating the type and field of skills needed in organizational creativity. Thus, in order to identify and reduce effectively competence gaps in any organization, it is required to exploit more advanced methods of the competence acquisition and development.

In launching the design of computer supported organizational creativity in the area of competences, the source and manner of their acquisition should be selected. As already mentioned, competences may be obtained inter alia by learning from the competition (tracing, monitoring, public relations, benchmarking, sponsoring, franchising). Commonly, the competition competences are not freely available, and the market and business setting find out about their existence with the moment of launching a new product and/or service. Therefore, the application of this method is complex and requires some preparatory arrangements, namely: (1) the identification of sector/industry and the competition that has the competences required by an organization, (2) the identification of sources which can be used to acquire „competence identifiers" (names of competences), (3) the identification of sources and manners to acquire specific competences, (4) the exploration of ability to acquire specific competences and their application in organizational creativity.

Assessing the attractiveness of the various sources of information which can be exploited to derive information about the development and/or exploration of competences by the competition or even a selected industry (e.g. IT sector), we recognize job advertisements as being a very attractive form of information sources. They constitute the basis for developing the set of competences required and desired by the market at the particular moment. Especially websites with job offers seem a convenient source of information

(e.g. http://pracuj.pl, http://gazetapraca.pl). Initially, it seemed that information on the desired competences included in the Web sites can be downloaded once manually (by opening a single page of each job advertisement and copying the selected content into a table, e.g. spreadsheets). However, in the case of organizational creativity, carrying out this task every day by hand is very time consuming and not efficient (usually, once a month, there are around several thousand job advertisements on the site in selected industries). It is more suitable and convenient to download information on the required competences automatically (e.g. using appropriate software) and focus on the analysis of the obtained information, not on their manual retrieval.

Undertaking studies related to the development of the system supporting organizational creativity in the area of competences, its overall functionality has been established. It consists of the following functions of webscraping type, such as:

- creating a list of hyperlinks to particular (single) job advertisements (function ListaHiperłączy/Hyperlinks) for the selected portal of job advertisements (e.g. Pracuj.pl). Next, in the loop for search and download from websites for a single link to the single job advertisement, by proprietary Regular Expression functions (Mitkov, 2003; Lawson, 2003), they have to be saved into a *LinkiAtomowe.txt* file containing the websites of particular job advertisements,
- in the loop, downloading data from particular websites related to specific (single) job advertisements from the Pracuj.pl portal (function PositionRequirementsCompany),
- downloading the website into the function from the *LinkiAtomowe.txt* file,
- downloading desired and needed data (e.g. job title, job description, competences for a given position, place of work, company conducting the recruitment, date of job advertisements entry) from selected elements (div containers) of the website with the single job advertisement,
- saving the data in the csv (comma-separated values) form into a *ogloszenieKompetencjeStanowiska.txt(advertisementCompetencesPositions.txt)* file containing the list of competences for the particular job advertisements.

The final effects of design works are the two integrated applications. The first program, *WLinkiAtom.exe*, is a window application (GUI); and the second one, *COgloszenieAtom.exe*, is a console application. Both applications work on the data from the web, therefore access to the Internet, namely to the http://Pracuj.pl portal is necessary for their application.

Using the *WLinkiAtom.exe* application, from the full source code of the website with filtered job advertisement, the list of hyperlinks to single job advertisements is generated. This stage goes relatively smoothly and its duration, depending on the Internet connection speed, takes a few seconds. The final result of the *WLinkiAtom.exe* application is the text file, *LinkiAtomowe.txt*, containing the list of links to particular job advertisements (Figure 1). Thus, this is the last step of this application, and its output data is also input data for the *COgloszenieAtom.exe*. application.

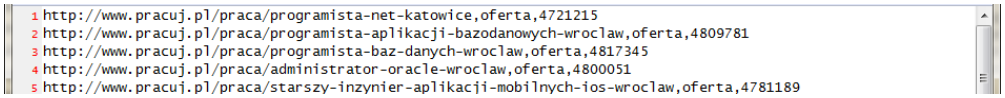

Figure 1 LinkiAtomowe.txt file with the list of hyperlinks to particular job advertisements, Source: Own study.

The COgloszenieAtom.exe application extracts data from atom job advertisements (Figure 2) from websites containing individual job advertisements from http://Pracuj.pl. Input data for the COgloszenieAtom.exe application is the LinkiAtomowe.txt file, i.e. the list of links to the websites generated by the WLinkiAtom.exe application.

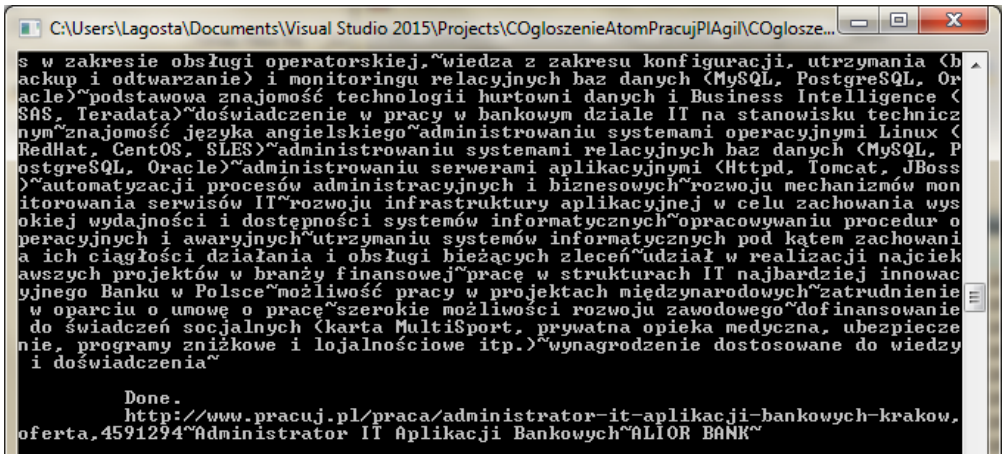

Figure 2 Screenshot example of COgloszenieAtom.exe – extracting selected elements of job advertisements, Source: Own study.

The final effect is the list including: links to job advertisements, job titles, required competences for positions for which recruitment is conducted, and other useful information. This step also runs automatically but is much longer in comparison to the first one. With about 100 job advertisements, its duration, depending on the Internet connection speed, takes from a few to several minutes.

Information obtained from the selected job advertisements (for the case of http://Pracuj.pl) are stored in a repository of data, so there is a possibility to process, analyse, and share freely the data through proprietary computer-supported organizational creativity. Every user of the repository with a Web browser can access the data collected in a central repository, and they can be independently viewed, analysed, commented, and shared with others.

4 Conclusion

To sum up, it should be emphasized that organizational creativity can be understood as an opportunity in the search for competitive advantage and organizational development. On the other hand, without the development of competences while acquiring and expanding information resources from useful and valuable sources (including online database of patents, publications, collections of articles, comments on the selected topic, e.g. Internet reviews on the product), the organization will fail to maintain the desired level of organizational creativity. The dynamism and competitiveness of the market means that the organization is not expected to develop incidental creativity; creativity is needed repeatedly and regularly. It is the competence of individual employee(s) that makes up organizational competences, may affect positively the continuity of creativity, and be useful in processing the acquired knowledge into new ideas.

The main conclusion from the design works is that organizational creativity needs, on the one hand, the continuous acquisition, exploitation of knowledge, creation of new ideas using the acquired knowledge, and the sharing of ideas developed. On the other hand, it needs the search, identification, and acquisition of competences that are desired by organizational creativity. Therefore, computer supported organizational creativity should give the ability to reach quickly many interesting sources of information and to identify competences that are currently attractive in

particular industry. Computer supported organizational creativity should result mainly from the volatility, dynamics, process, lack of structure (Mumford, et al., 2011; Mumford, et al., 2012) and teaming (Andriopoulos, Dawson, 2014).

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Application of the Decision Analysis in IT Department

Blanka Bazsová[1]

Abstract. The aim of this paper is to use the decision analysis for the purpose of selection of an employee of IT Department. The decision analysis is one of the methods serving for the support of managerial decision making that is used during solving problems, for which we usually make decision on the basis of several criteria. The decision analysis is one of the multi-criterial multi-purpose methods used practically in all spheres of the enterprise management.

Keywords: Criteria, decision analysis, problem solving, criteria, matrix, utilities

JEL Classification: M51, M54

1 Introduction

The managerial decision making is one of the most important activities executed by managers. It is usually used not only in the enterprise management, but also in the strategical management, the organizational diagnostics and the personnel sphere. Optimal utilization of human resources contributes to achievement of the aims of IT department and also of the entire company (Ministr, 2013). The quality of the manager decision influences the effectiveness of separate activities and operation of the enterprise itself, the company's position, as well as prestige and recognition of the manager within this enterprise (Hanclova et all., 2015). If is the manager experienced and has the leadership skills, it contributes to the better performance of the department and whole organization (Řeháček, 2015). Speaking theoretically, we conceptualize the decision making as a process of selection between two possibilities or variants. The result of it is selection of the best version, which complies best with the specified criteria (aspects of the target of the decision making). Practically the decision making has multi-criterial dimension; it means that we make decision not on the basis of one criterion, but on the basis of several criteria.

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According to Fotr and Švecová (2010), the decision making can be divided on two basic aspects, namely the meritorious aspect (subject, content aspect) and the formal-logical aspect (procedural one). The meritorious aspect focuses on the sphere of usage in different scientific subjects, for example, marketing, finance and personal sphere; the procedural aspect reflexes differences of separate decision-making processes and methods (procedures)

Hrůzová (2007) specifies that the decision making has similar and characteristic features, for example, the decision-making stages, procedures and methods. It is a matter of the formal-logical aspect.

Fotr, Dědina and Hrůzová (2003) differentiates good-structured problems and bad-structured problems. In case of the bad-structured problems, it is necessary that the subject of the decision making uses a creative attitude, extensive knowledge and experience, as well as formalized methods and procedures, i.e. heuristics. These problems cannot be solved by means of a single-shot decision-making.

According to Fotr and Švecová (2010), a lot of factors influence the process of decision making. The most significant of them are:

- character and obligation of the decision-making problems,
- conditions for decision making (available time, reaction speed, level of risk and uncertainty …)
- manager personality, his experience, style and attitude to the decision making.

2 Decision- making Analysis

Decision-making analysis is one of universal heuristic methods applicable in every part of managers´ activities. It describes the decision-making process structure. Phases of decision-making analysis are:

1. Problem definition and goal setting
2. Determination of criteria
3. Development of variants
4. Evaluation of utility of variants
5. Risk evaluation
6. Decision making and justification

At first we start with the description of the problem. Problem should be described clearly. Then we have to set the goal. If we ended the problem definition we create the list of criteria and variants. In the next steps we evaluate them by using various multi-criteria decision making methods. We implement for the evaluation of the variants 3 matrixes - matrix of absolute utilities, matrix of simple utilities and matrix of weighted utilities.

Table 1 Matrix of absolute utilities, Source: adapted from Zonková, 1995.

Criteria	**Criteria expression**	**V_1**	**V_2**	**….**	**V_n**
C_1	verbal	Excellent	Bad	…	Good
C_2	currency	10 000 CZK	12 000 CZK	…	13 000 CZK
…	Distance	6 km	7 km	…	8 km
C_m	Verbal	Excellent	Very good	…	Good

Table 2 Matrix of simple utilities. Source: adapted from Zonková, 1995.

Criteria	**V_1**	**V_2**	**….**	**V_n**
C_1	100	10	…	50
C_2	50	60	…	100
…	…	…	…	40
C_m	40	100	…	50

Table 3 Matrix of weighted utilities. Source: adapted from Zonková, 1995.

Criteria	**Weight**	**V_1**	**V_2**	**….**	**V_n**	**V_{max}**
C_1	5	500	50	…	300	500
C_2	1	50	60	…	100	100
…	…					
C_m	2	80	200	…	20	200
Total utility		$\sum V_1$	$\sum V_2$	…	$\sum V_n$	$\sum V_{max}$
Relative utility		$\frac{\sum V_1}{\sum V_{max}}$	$\frac{\sum V_1}{\sum V_{max}}$		$\frac{\sum V_1}{\sum V_{max}}$	

3 Case study

Problem description and characteristics:

A company active advertised a tender for the position of IT administrator in IT department. The tender was held in Mai, 2015 and the selection was to be made by a commission. 3 candidates participated in the tender. They sent their CVs and motivation letters. The objective of the selection committee is to select a person to fill the position of IT administrator.

Analysis of decision making factors, determination of criteria and rules:

Table 4 The following criteria were determined: achieved education level, experience in the industry, knowledge of computer networks, knowledge of other computer platforms, communication skills and foreign language proficiency. The figure 1 shows comparison of criteria using Fuller´s triangle. The Fuller´s triangle enables to de, 0termine the number of selections and calculate the weight of different criteria which is detailed in the table (Bazsová Křížová and Řeháček, 2015)

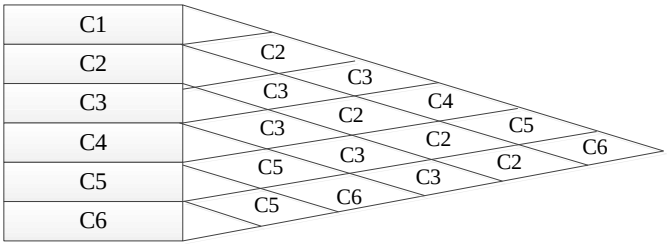

Figure 1 Determination of weight of criteria by using the Fuller´s triangle. Source: own.

Recognition and development of variants:

The following facts were identified from the CVs and motivation letters:

Description of the variants:

Variant No. 1: Tenderer No. 1: Bc. Steve Fisher.

Achieved education level: Bachelor, *experience in the industry*: 4 years, knowledge of computer networks: MS Server 2008 and Oracle, knowledge of other computer platforms: Java, communication skills: satisfactory, foreign language proficiency: English - at communication level.

Variant No. 2: Tenderer No. 2: Ing. Charles Roof.

Achieved education level: technical university, experience in the industry*:* 2 years, knowledge of computer networks: MS Server 2008 and

Oracle, knowledge of other computer platforms: Java, communication skills: excellent, foreign language proficiency: English - speaking and writing.

Variant No. 3: Tenderer No. 3: Joseph Weber.

Achieved education level: high school, experience in the industry: none, knowledge of computer networks: Oracle, knowledge of other computer platforms: none, communication skills: good, foreign language proficiency: English at communication level.

The information above is processed at first using the matrix of absolute utilities, matrix of simple utilities and matrix of weighted utilities which are detailed in table 4, table 5 and table 6.

Table 5 Matrix of absolute utilities. Source: own calculation.

Criteria	**V_1**	**V_2**	**V_3**
C_1	Bachelor	Technical University	High school
C_2	4 years	2 years	none
C_3	MS Server 2008, Oracle	MS Server, Oracle	Oracle
C_4	Java	Java	none
C_5	satisfactory	excellent	good
C_6	At communication level	Speaking and writing	At communication level

Table 6 Matrix of simple utilities. Source: own calculation

Criteria	**V_1**	**V_2**	**V_3**
C_1	80	100	50
C_2	100	80	0
C_3	100	100	50
C_4	100	100	0
C_5	80	100	60
C_6	70	100	70

Table 7 Matrix of weighted utilities. Source: own calculation.

Criteria	Criterion weight	V_1	V_2	V_3	Vmax
C_1	1	80	100	50	100
C_2	5	500	400	0	500
C_3	6	600	600	300	600
C_4	2	200	200	0	200
C_5	4	320	400	240	400
C_6	3	210	300	210	300
Total utility		1910	2000	800	2100
Relative utility		**90,9 %**	**95,24 %**	**38%**	

Forecasting of variant selection consequences:

The forecasting of variant selection consequences consists in identification of the risks listed below which are subjected to pairwise comparison. This is illustrated on Figure 2.

AF1 – Will not fit in the collective due to absence on company events

AF2 – Conflicts with managers due to conflict of natures

AF3 – Irresponsibility, poor working attitude, poor results

AF4 – Inability to work due to high sickness absence level, care for children, etc.

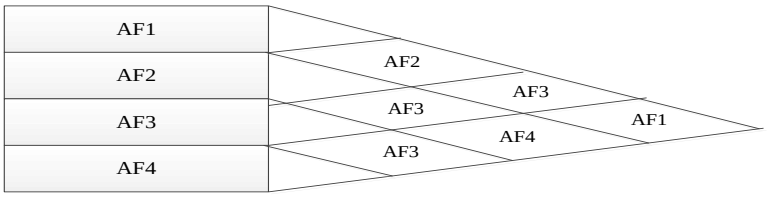

Figure 2 Fuller´s triangle for the pairwise comparison of the adverse factors. Source: own.

Table 8 Weights of different adverse factors Source: own calculation.

Criteria	Number of selections	Weight
AF_1	1	1
AF_2	1	3
AF_3	3	4
AF_4	1	2

Following the pairwise comparison of risks the weights of different adverse factors (AF) were determined which is shown in Table 7. To express the total and percentual share of risk posed by the different variants, the threat degree must be calculated which is shown in Table 8.

Table 9 Matrix of adverse factors. Source: own calculation.

*Lik = Likelihood

Criteria	Weight	Lik*	L1	Lik*	L2	Lik	L3	Lik	Level of threat
AF_1	1	0,2	0,2	0,3	0,3	0,2	0,2	1	1
AF_2	3	0,6	1,8	0,1	0,3	0,1	0,3	1	3
AF_3	4	0,3	1,2	0,1	0,4	0,5	2,0	1	4
AF_4	2	0,3	0,6	0,3	0,6	0,3	0,6	1	2
Total			3,8		1,6		3,6	-	10
Risk			**38%**		**16%**		**36%**	-	100%

Table 10 Evaluation of order according to utility and risk. Source: own.

Order	1.	2.	3.
According to utility (U)	2.	1.	3.
According to risk (R)	3.	1.	2.

Analytic assessment of the variants:

V1 – Bc. Steve Fisher: Steve's advantage is his experience in the industry, knowledge of computer networks and Java. For that reason it would not be difficult to provide induction training to him.

V2 – Ing. Charles Roof: Charles´s advantage is his education and good English speaking and writing skills. This is actually of importance for the company because it has entered into contracts with foreign partners and intends to implement foreign projects.

V3 – Joseph Weber is a person with secondary education and without any experience. The company would have to provide several months' induction training to him. However, his advantage is his young age so he can be expected to quickly fit in the collective and, in addition, to present opinions and attitudes not conflicting with the director.

4 Conclusion

Charles Roof was selected as the most appropriate candidate for the position specified above based on objective assessment, i.e. application of decision making analysis, as indicated in table 9. The two tables suggest that ing. Charles Roof best meets the defined criteria and poses the lowest risk.

The above mentioned example is a proof of that the decision analysis can be used during determination of criteria and selection of versions between separate candidates for a job position and can become an integral part of the selection procedure. Its usage in personnel sphere is unambiguous.

Acknowledgements

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Education of Software Quality Specialists on the Basis of Academic-industry Collaboration

Alena Buchalcevova[1]

Abstract. Based on an actual intensive demand for university educated specialists in the area of software quality and testing, this paper presents a concept of education of these specialists designed at the Faculty of Informatics and Statistics at the University of Economics in Prague. The Software Quality Assurance minor was prepared and newly opened. The aim of the SQA minor is to equip students with theoretical knowledge and practical experience in the software quality assurance and testing area. The development of the SQA minor along with the Software Quality Assurance Competence Centre represents a real example of an academic-industry collaboration.

Keywords: Software Quality Assurance, minor, Competence Centre, internship.

JEL Classification: M15

1 Introduction

With an increasing role of software in a society, application development starts to focus on the issue of quality as a way of gaining a competitive advantage (Orso and Rothermel, 2014; Osterweil, 1996).

This trend was facilitated by the financial and economic crisis as, companies strived to minimize their IT related costs, increase operational efficiency and profit. The merits that distinguish strong software companies from their competitors are quality, reliability and low maintenance costs of software.

As the role of software quality grows, the issue of human resources that actively take part in the development process and shape the quality of produced software becomes an important success factor, especially the level of knowledge and experience. However, the research focused on the level of testing and quality management in software companies in the Czech Republic (Havlickova, 2012) indicated a low availability of managed and structured training on quality management and testing that is intended for particular employees. This fact provides an opportunity for universities to provide an

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expert guidance in this field. The knowledge of academics and their experience from the research field represents a substantial source of know-how as well as an opportunity to enhance company's processes and operation. On the other hand, collaboration with practice provides universities with an insight in practical business world and helps them to enrich course syllabus with real life situations and also to better prepare their students for their future career.

On the other hand, several surveys worldwide and also in the Czech Republic (Doucek, Maryska and Novotny, 2014; Pilgrim, 2013) point out existing tensions between universities and industry as to the design of ICT curriculum.

To meet the growing needs of practice in the area of software quality and testing, it is necessary to educate students with adequate knowledge and skills (Eldh and Punnekkat, 2012; Rusu et al., 2009). Among others, a suitable way to do so is to enable students to participate in practical projects through an industry and academia collaboration. There is a significant amount of research that shows the importance of such a collaboration (Mandviwalla et al., 2015; Wohlin, 2013), presenting its benefits (Lee, 2000), challenges (Runeson, Minör and Svenér, 2014) and gained experience (Bučar and Rojec, 2015).

The aim of this paper is to show the possibilities of the academic-industry collaboration in the field of Software Quality Assurance (SQA). The real outcomes of this collaboration are the Software Quality Assurance minor intended for major students at the University of Economics in Prague and the Software Quality Assurance Competence Centre (SQA CC).

This paper is organized as follows. First, the importance of SQA within IS development is outlined. Second, the concept of education of software quality specialists at the Faculty of Informatics and Statistics at the University of Economics in Prague is presented. Then, the Software Quality Assurance Competence Centre (SQA CC) is introduced with its main services for business customers. Finally, concluding remarks are stated.

2 Education of Quality Engineers within Software Quality Assurance Minor

The demand for university educated specialists in the software quality and testing area in the Czech Republic has been growing strongly in recent years.

The practices of some companies that hire temporary workers and unqualified testers for manual testing proved to be wrong. Companies lack qualified specialists, especially test analysts and automation testers for functional, performance or integration testing.

To introduce the concept of study at the University of Economics, generally the Master degree study includes two different specializations, major and minor. The whole program consists of 120 ECTS, out of which minor accounts for 30 ECTS. This concept provides students with education in other areas in addition to their main specialization and thus supplements their chief focus. At the Faculty of Informatics and Statistics, individual Software Testing and Software Quality Assurance courses have been taught as optional courses within the Applied Informatics undergraduate program and Information Technologies graduate program for more than 10 years. Further, the entire Software Quality Assurance minor has been prepared newly.

The aim of the SQA minor is to equip students both with theoretical knowledge and practical experience in the software quality assurance and testing area and to enable them to acquire a professional career as:

- IS quality managers,
- Test managers,
- Test analysts,
- Automation testers for functional, performance and integration testing.

The Software Quality Assurance minor is intended not only for students of the Information Technologies major but also for students of all faculties as:

- Faculty of Business Administration,
- Faculty of International Relations,
- Faculty of Finance and Accounting.

The study plan consists of compulsory and optional courses. The amount of 18 ECTS is determined for compulsory courses described in Table 1.

Table 1 Compulsory Courses

Ident1	Name	ECTS
4IT446	Software Quality Assurance	6
4IT473	Software Test Management and Supporting Tools	6
4IT474	Test Analysis and Design	6

After a successful completion of compulsory courses, students shall understand software quality management principles and processes, know software quality management frameworks, methodologies and standards, understand software test management activities and be able to prepare test management documentation. They will gain practical experience with test management supporting tools and test case and test script design.

Optional courses are for students to choose from a number of specific courses amounting to 12 ECTS. The list of optional courses is shown in Table 2. Since the minor is intended for students of all faculties, among optional courses are also courses that supplement the basic knowledge in Information Technology (they are marked with * and are available only for students that did not graduate from the bachelor program Informatics).

Table 2 Optional Courses

Ident1	Name	ECTS
4IT477	Software Testing Internship	6
4IT478	Automated Functional Software Testing	3
4IT476	Software Load Testing and Performance Optimization	3
4IT475	System Integration Testing	3
4IT479	Software Testing in Agile Projects	3
3PS422	Training of Social and Managerial Skills	6
4IT215*	Information Systems Analysis and Design	7
4IT218*	Databases	6

Optional courses deepen student's knowledge in specific areas. After a successful completion of Automated Functional Software Testing course, students will be able to develop and execute automated functional tests and use functional testing automation tools. The aim of the Software Load Testing and Performance Optimization course is to present fundamentals of software performance testing discipline, system bottleneck analysis and performance optimization. Students will understand software performance test types and the importance of software performance testing. They will be able to prepare and perform software load tests and analyse their results. They will also gain experience with software load testing tools. The objective of the System Integration Testing course is then to educate students with the system integration testing principles and techniques and explain the use of system integration testing tools. After completing the Software Testing in Agile Projects course, students will understand fundamental agile testing principles, practices and processes. Thus, they will be able to use agile testing methods and technics.

The Software Testing Internship course constitutes a core element of the SQA minor as it interconnects academia and industry. From the student's point of view, this course represents a possibility to gain practical experience in testing, ideally in a specific area studied within optional courses. On the other hand, it is also favourable for companies that have the chance to involve qualified students in their projects and possibly also as future employees. Companies can choose from outstanding students to work on their projects as the selection procedure is quite severe and competitive. By setting internship criteria, companies are able to specify a concrete set of skills required for different positions within the project. Students at the Faculty of Informatics and Statistics undergo a number of specific courses with a narrow focus, usually hard to find elsewhere. If both sides find their cooperation beneficial, they may enter into a long-term collaboration and train and prepare these young and talented students for employee positions in the company as the talent acquisition gets tough in present days. In addition, the internship program brings along low labour costs and thus helps companies with the project cost efficiency.

The internship is carried out in a collaboration with companies, i.e. partners of the Software Quality Assurance minor, within the SQA competence centre and business accelerator xPort. Besides, it is also possible for the

students to obtain the internship themselves. Companies interested in student internships are registered in a database as potential internship implementers, including a contact person for the company. Prior to the beginning of each semester, an internship guarantor contacts all companies and their contact persons to arrange concrete possibilities for student's involvement in the internships with the company for the upcoming semester. That means, whether it is possible to offer students an internship place, define the number of available internships, identify suitable projects and their specific focus, set an overall duration and distinctive requirements on student's knowledge and skills. Based on this overview, an internship offer for students is established and announced in order to enable students to find a perfect fit.

In case a student chooses his internship and at the same time meets company's requirements, a Professional Internship Agreement is concluded available in a standard ready-made form. The agreement is signed by an accountable person on behalf of the company, by an accountable person on behalf of the University of Economics and by the student. The agreement specifies primarily the conditions of such internship, in particular the number of hours worked, internship dates and duration, work days, specific focus, etc. If a company has additional requirements, for example on a non-disclosure agreement (NDA), etc., it enters into a separate agreement with the student.

Signing the agreement follows the professional internship itself held at the work place of the project. The internship totals to a minimum of 104 hours worked.

Students regularly keep a record of their activities within the internship (an internship diary). The accountable person from the company signs the internship diary on a regular basis and at the end of the internship provides an evaluation on student's performance which is the basis for an overall evaluation of the internship and grading. The accountable person from the University of Economics regularly checks the internship diary, provides a supervision and is available for consultations.

At the end of the internship, students are obliged to write a Report on Professional Internship submitted and presented to other students and the internship guarantor, possibly also to the company representatives, at the end of the semester.

The minor is completed by a state exam. Students may write their diploma thesis also on a topic taught within the minor and then defend it at the state exam.

The whole specialization is prepared in a tight cooperation with industry and most courses are taught by test professionals. The SQA minor is opened from the academic year 2016/2017. Right in the first year, a total of 30 students signed up for the minor.

3 Academic-industry Collaboration within SQA Competence Centre

The Software Quality Assurance competence centre (SQA CC) has been operating at the Faculty of Informatics and Statistics, University of Economics in Prague since 2012. The aim of this competence centre is to provide companies with expert advice and guidance in planning and implementation of software quality management processes, especially in testing.

The SQA Competence Centre has currently over 20 members. These include PhD students, students of bachelor and master programs of Informatics and Information Technologies. The plan is to involve also students from other faculties of the University of Economics, particularly in the area of project management and marketing. Within the competence centre, students have the possibility to participate in real and practical business and research projects during their studies and thus gain valuable experience. We also focus on their personal development and organize internal training and educate them within regular as well as block courses. Within bachelor and diploma theses, students develop a number of methodologies and manuals that serve as a basis for other students and also for educational purposes. Within the SQA Competence Centre, we collaborate especially with the following companies:

- NESS Czech, s.r.o. ,
- HEWLETT-PACKARD, s.r.o. ,
- TRASK SOLUTIONS, a.s. ,
- IBM Czech Republic, s r.o. ,
- Tesena s.r.o. ,
- T-Mobile Czech Republic, a.s.,
- MSD.

The SQA Competence Centre offers a wide variety of services in the field of quality management, which includes know-how and special skills that are not usually available in the practice. These include:

- Automated functional testing using commercial and open source tools,
- Performance testing,
- Integration testing,
- Mobile application testing,
- Testing methodology implementation,
- Testing tools integration.

These areas are in compliance with the concerns stated by Engström and Runeson (2010) based on the recent survey of regression testing practices and challenges pointed out by Orso and Rothermel (2014).

Two examples of SQA Competence Centre successful projects, i.e. the REGAN (REGression ANalysis) project and Integrated Testing Tool (ITN) project, are in detail described in (Buchalcevova, 2015).

4 Conclusion

The aim of this paper was to outline the concept of education of software quality specialists based on the academic-industry collaboration designed at the Faculty of Informatics and Statistics at the University of Economics in Prague. With an increasing role of software quality as a competitive advantage, the issue of human resources within software development becomes an important success factor. Despite its importance, a lack of structured training on software quality and testing was identified in Czech software companies. Thus, the Faculty of Informatics and Statistics continuously develops its education framework to address such issues. This paper presented the overall education concept focusing on the newly opened Software Quality Assurance minor with its core courses. Among these, the Software Testing Internship course represents a key element of the academic-industry collaboration as it provides students with practical experience and companies with specific knowledge. At present, it is a pioneer course among IT university programmes in the Czech Republic. To enhance the academic-industry collaboration, the Software Quality Assurance Competence Centre is operating at the Faculty of Informatics and Statistics since 2012. Its main goals and services provided to

business customers were described highlighting its contribution to the education of software quality specialists.

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Numeric Evaluation of Selected Statistical Software for Data Analysis and Modelling

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Abstract. This article presents way of evaluating for advanced analytics software. Such software is also referred to as statistical software, tools for data science, statistical analysis, machine learning, artificial intelligence, predictive analytics, business analytics, and is also a subset of business intelligence. The paper deals with seven most used statistical software used today in commercial as well as academic area; we have chosen seven statistical programs for our comparative analysis – Eviews, gretl, R, IBM SPSS, STATA, Statgraphic and Statistica. After discussing the main features of these software, we suggest methodology for evaluating this software. The methodology include evaluation on base of functionality and evaluation on base of other features such as price, environment, extension ability and operating system support. The final ranking is counted according to the formula we suggest in the paper. On base of our comparative analysis the R software outperformed all other statistical programs. Finally, we discuss the software selection for various user groups.

Keywords: statistical analysis, R, gretl, STATA, SPSS.

JEL Classification: C13, G32

1 Introduction

As quantitative research grows, application of statistical software becomes a more crucial part of data analysis. Researchers are experiencing a transition from manual analysis with paper to more efficient digital/electronic analysis with statistical software. It identifies the prerequisites of producing world-class studies by using modern statistical software solutions.

The software can differ in what area of modelling they are used in, to what extent they are able to use different econometric methods and methods for data analysis. Also, very often, what they differ in is the price of the software, too.

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It is obvious that that every group of users have different demands on this software. While in academics it is often demanding the software to be free, for big companies like T-Mobile or Deutsche Bank the price is not a problem. Also, it is true that commercial programs such as SPSS, SAS or E-views dispose by a large number of functions, they are very user friendly, they have beautiful graphs and outputs and documentation is also on high level. But the main disadvantage of these programs is their price. They cost very much money and even if it is not a big deal for a big IT company, there is only small amount of schools, universities, small companies and other non-profit institutions that can afford to buy this kind of software. Fortunately, for those kind of people, open source programs exist.

Due to the fact that there exist a lot of possibilities of statistical software, we decided to compare the most known and the most used ones. This article presents various ways of evaluating for advanced analytics software.

For example, Okunade, A., and others (1993) compared the output of summary statistics of regression analysis in commonly statistical and econometrical packages such as SAS, SPSS, SHAZM, TSP, and BMDP. Oster, R. A. (1998) reviewed five statistical software packages (EPI INFO, EPICURE, EPILOG PLUS, STATA, and TRUE EPISTAT) according to criteria that are of most interest to epidemiologists, biostatisticians, and others involved in clinical research. McCullough B. D. (1998) proposed testing the accuracy of statistical software packages using Wilkinson's Statistics Quiz in three areas: linear and nonlinear estimation, random number generation, and statistical distributions. Then, McCullough B. D. (1999) applied his methodology to the statistical packages SAS, SPSS, and S-Plus. McCullough concluded that the reliability of statistical software cannot be taken for granted because he found some weak points in all random number generators, the S-plus correlation procedures, and the one-way ANOVA and nonlinear least squares routines of SAS and SPSS. Zhou, X., and others (1999) reviewed five software packages that can fit a generalized linear mixed model for data with more than a two-level structure and a multiple number of independent variables. These five packages are MLn, MLwiN, SAS Proc Mixed, HLM, and VARCL. The comparison between these packages were based upon some features such as data input and management, statistical model capabilities, output, user friendliness, and documentation.

2 Statistical Software

In the following section selected specialized statistical programs will be discussed. We have chosen the most known and the most used statistical software. In these programs it is possible to perform all kind of standard statistical procedures. However, some advanced features are only available in just some of them.

2.1 R Project

Project R is a very popular software among lots of universities all over the world. The software itself can be downloaded on the webpage http://www.r-project.org. This tool is great mainly for statisticians and mathematicians as it contains lots of build in statistical functions. The main advantages of this software include: easy accessibility – the program is for free as it belongs to the Open Source software; active user support all over the world; it runs on various platforms including Windows, Linux and macOS; wide range of constructed functions. Moreover, there exist hundreds of packages (more than 1600), each of them specializing in some specific area (machines, genome analysis, financial analysis, etc.) In R there is also a large, coherent, integrated collection of intermediate tools for data analysis. Finally, R is able to plot great charts and graphical facilities for data analysis.

As stated above, a thing what makes R so useful — and helps explain its quick acceptance — is that statisticians, engineers and scientists can improve the software's code or write variations for specific tasks. Packages written for R add advanced algorithms, colored and textured graphs and mining techniques to dig deeper into databases. For example, a package, called BiodiversityR, offers a graphical interface aimed at making calculations of environmental trends easier. The financial services community has also demonstrated a particular affinity for R; dozens of packages exist for financial analysis alone. One of the best sources for working in R is the book by Crawley (2012). The book by Zivot and Wang (2006) focuses almost exclusively on modelling in R. The R manual headed by Mrs. Pancikova is the initiative of the R fans at University of Žilina (Pančíková, 2016).

In addition to that, due to possibility to make R nearer to standard Windows users many graphical user interfaces which serve as an upgrade to the standard R have been created, e.g. Rstudio, Rattle, Deducer etc.

2.2 gretl

Gretl is an acronym for Gnu Regression, Econometrics and Time-series Library. It is an open-source statistical software package with the main focus being on statistical methods for econometric analyses. This software package, mainly for doing econometrics, is easy to use and reasonably powerful. Even though originally developed on Linux, gretl is now available also on Microsoft Windows and Mac OS X. It is available for free according to the GNU General Public License and it can be downloaded from http://gretl.sourceforge.net. One of the main advantages of gretl is the GUI interface, i.e. a user need not to know the exact commands as the point-and-click interface is present in this software.

The main features of gretl according to [1] are as follows:

- Easy intuitive interface (now in French, Italian, Spanish, Polish, German, Basque, Portuguese, Russian, Turkish and Czech as well as English)
- A wide variety of estimators: least squares, maximum likelihood, GMM; single-equation and system methods
- Time series methods: ARMA, GARCH, VARs and VECMs, unit-root and cointegration tests, etc.
- Limited dependent variables: logit, probit, tobit, interval regression, models for count and duration data, etc.
- Output models as LaTeX files, in tabular or equation format
- Integrated scripting language: enter commands either via the GUI or via script
- Command loop structure for Monte Carlo simulations and iterative estimation procedures
- GUI controller for fine-tuning Gnuplot graphs

Except for this, gretl supports a wide range of statistical methods, with a focus on methods used in econometrics, especially regression methods. For cross-sectional data one can estimate several linear models, besides OLS also weighted least squares, two-stage least squares and least absolute deviation regression as well as many nonlinear models, such as logit, probit, tobit, heckit, Poisson, logistic and non-linear least squares. One can also specify and estimate maximum likelihood, generalized method of moments (GMM) and simultaneous equations models, with the latter including seemingly unrelated

regressions (SUR), ordinary or weighted least squares, two- or three-stage least squares and full or limited information maximum likelihood estimators. For panel data one can estimate, e.g., models with fixed or random effects and dynamic panel models.

Likewise, for time series data a wide range of analysis methods are available, including filtering with simple and exponential moving average, the Hodrick-Prescott filter and Baxter-King band pass filter, ADF, ADF-GLS and KPSS unit root tests as well as Engle-Granger and Johansen cointegration tests, estimation using the Cochrane-Orcutt, Hildreth-Lu and Prais- Winsten estimators, and modeling with ARIMA, ARCH/GARCH, VAR and VECM. Besides these built-in methods, gretl is also integrated with the two external time series software packages X-12-ARIMA and TRAMO/SEATS.

2.3 SPSS

IBM SPSS Statistics (formerly SPSS Statistics) is an acronym for Statistical Packages for Social Sciences and is a software for managing data and calculating a wide variety of statistics. The SPSS software is built around the SPSS programming language. The good news for beginners is that you can accomplish most basic data analysis through menus and dialog boxes without having to actually learn the SPSS language. Menus and dialog boxes are useful because they give you reminders of (most of) your options with each step of your analysis. Generally, SPSS is a package that many beginners enjoy because it is very easy to use. [2] SPSS has a "point and click" interface that allows you to use pulldown menus to select commands that you wish to perform. SPSS does have a "syntax" language which you can learn by "pasting" the syntax from the point and click menus, but the syntax that is pasted is generally overly complicated and often unintuitive.

SPSS has a friendly data editor that resembles Excel that allows you to enter your data and attributes of your data (missing values, value labels, etc.) However, SPSS does not have very strong data management tools. SPSS primarily edits one data file at a time and is not very strong for tasks that involve working with multiple data files at once. There is no limit to the number of variables or cases allowed in your SPSS data files - you are only limited only by your disk space.

As for statistical analysis, SPSS performs most general statistical analyses (regression, logistic regression, survival analysis, analysis of variance, factor analysis, and multivariate analysis). The greatest strengths of SPSS are in the area of analysis of variance (SPSS allows you to perform many kinds of tests of specific effects) and multivariate analysis (e.g., MANOVA, factor analysis, discriminant analysis) and SPSS 11.5 has added some capabilities for analyzing mixed models. The greatest weakness of SPSS is probably in the absence of robust methods (we know of no abilities to perform robust regression or to obtain robust standard errors), and the absence of survey data analysis in the basic package (some procedures are available in an add-on module in SPSS version 12).

2.4 Statgraphic

Statgraphics is a statistics package that performs and explains basic and advanced statistical functions. The software was created in 1980 by Dr. Neil Polhemus while working as a professor of statistics at Princeton university. The current version of the program, STATGRAPHICS Centurion XVI.II is a powerful data analysis tool that combines a broad range of procedures with brilliant interactive graphics to provide an integrated analytical environment that can be applied in every aspect of business operations, from Six Sigma management protocols to quality control initiatives. It provides more than 230 graphics and analysis and the software has an appropriate visualization for each statistical analysis. The handling is very easy owing to its intuitive user interface. It is designed with advanced statistical functionality, significant enough for use by the most seasoned statisticians, yet its incredibly intuitive interface provides simplicity sufficient to allow even a novice analyst to perform complex procedures. [4]

2.5 STATA

Stata is a general-purpose statistical software package created in 1985 by StataCorp. It is a package that many beginners and power users like because it is both easy to learn and yet very powerful. Stata uses one line commands which can be entered one command at a time (a mode favored by beginners) or can be entered many at a time in a Stata program (a mode favored by power users). Even if you make a mistake in a Stata command, it is often easy to diagnose and correct the error. [2] Most of its users work in research, especially

in the fields of economics, sociology, political science, biomedicine and epidemiology. Stata's capabilities include data management, statistical analysis, graphics, simulations, regression, and custom programming.

3 Results

We performed our comparison according to multiple evaluation criteria. First of all, we evaluated software according to functionality criteria – 6 different criteria were taken into account: descriptive analysis, ANOVA, regression, time series analysis and modelling, other analysis and charts. According to the fact if the specific software is able to perform standard and/or more advanced methods of selected methodologies (Table 1) we then assign points from 0 to ten (Table 2).

Table 1 Other criteria of evaluation of statistical software

Criterion		Eviews	gretl	R	SPSS	STATA	Statgraphics	Statistica
Price [EUR]		1295[1]	0	0	4760[2]	1080[3]	1360[4]	1040[5]
Environment								
	Interface GUI[6]	✓	✓	✓[8]	✓	✓	✓	✓
	Interface CLI[7]	✓	✓	✓	✓	✓	×	×
	Easy-to-use	7/10	10/10	2/10	9/10	7/10	8/10	8/10
Extension ability								
	Open-source	×	✓	✓	×	×	×	×
	Extensions/packages	×	×	✓	×	✓	×	×
OS support								
	Windows	✓	✓	✓	✓	✓	✓	✓
	Mac OS	✓	✓	✓	✓	✓	×	×
	Linux	×	✓	✓	✓	✓	×	×

[1] - Eviews 9.5 Standard
[2] - for premium version
[3] - STATA/IC
[4] - Statgraphics Centurion XVII Corporate Single-User Perpetual License
[5] - base edition
[6] - Graphical User Interface
[7] - command line interface
[8] - with upgrades only (Rattle, R Studio, …)

Except for functionality criteria we also took into account other facts, i.e. the price of the software, support of various operating systems, extension ability and environment.

Final ranking was composed of 10 criteria (6 of them was the functionality and 4 of them was "other" criteria). Every criterion had the weight of 10 points maximum and was evaluated according to partial criteria

stated in Table 1. The final ranking was calculated according to the following formula:

$$final = \frac{\sum_{i=1}^{N} \frac{\sum_{j=1}^{n} criteria_j^i}{wj}}{wN} \quad (1)$$

where w is the weight of every criterion (i.e. 10), N equals to number of final criteria (i.e. 10), i is i^{th} evaluated criterion, j is the j^{th} evaluated criterion of i^{th} criterion, n is number of evaluated criteria in i^{th} final criterion. Moreover, if there is a ✓ then $criteria_j^i = 10$ and if there is a ✗ then $criteria_j^i = 0$. The results of final ranking are stated in Table 3.

Table 2 Final ranking of evaluation of statistical software

	Eviews	**Gretl**	**R**	**SPSS**	**STATA**	**Statgraphic**	**Statistica**
Price	3/10	10/10	10/10	1/10	5/10	4/10	5/10
Environment	9/10	10/10	7/10	10/10	9/10	10/10	10/10
Extension ability	0/10	5/10	10/10	0/10	5/10	0/10	0/10
OS Support	7/10	10/10	10/10	10/10	10/10	4/10	4/10
Descriptive Statistics	10/10	10/10	10/10	10/10	10/10	10/10	4/10
ANOVA	2/10	2/10	10/10	10/10	10/10	8/10	8/10
Regression Modelling	9/10	7/10	10/10	5/10	10/10	9/10	9/10
Time Series Analysis & Modelling	10/10	9/10	10/10	2/10	10/10	2/10	2/10
Other Analysis	0/10	0/10	10/10	10/10	10/10	10/10	10/10
Charts	10/10	10/10	10/10	10/10	10/10	10/10	10/10
TOTAL	60	73	97	68	89	67	62
Final percentage	60%	73%	97%	68%	89%	67%	62%
Ranking	**7.**	**3.**	**1.**	**4.**	**2.**	**5.**	**6.**

4 Conclusion

Today, there is a huge amount of statistical software available. Either it is proprietary either it is open-source, many solutions have many functionalities and therefore it is sometime difficult to get oriented between them. We performed the comparative analysis of the most known statistical software used nowadays. For our tests we selected Eviews, gretl, R, SPSS, Statistica,

Statgraphic and Stata. We evaluated software based on functionality and "other" criteria. As for functionality, we evaluated standard statistical features such as regression or time series analysis. However, we also evaluated some other more advanced features such as MANOVA, survival analysis, quantile regression etc.

Based on our methodology the software which achieved the best score and outperformed other statistical programs extensively is the R software. It achieved 97 points out of 100. It has everything the statistician need to have when analyzing or modelling. Moreover, it is free. If you do not have problem with some programming or writing commands the R is the clear winner for you. It is mainly used by statisticians. It has a great library support and visualization. The main con is the steep learning curve.

STATA was just behind the R in our evaluation. The advantage over the R is that is has better GUI and better environment. It however, it not free and open-source. Other rankings were as follows: gretl, IBM SPSS, Statgraphic, Statistica and Eviews. Nevertheless, it does not mean that for example Eviews software is bad or something. It is still a very good statistical software. If you are an econometrist or financial analysist you would probably go for Eviews as it has enormous time series modelling and a great support in this area of business.

On the other side if you are a student gretl seems to be a best choice. Even if it does not have all the feature such as STATA or R, it is pretty easy and is great for learning the basics of applied statistics or econometrics. Moreover, it is open-source and is free.

SPSS and Stata in the same category: they seem to have a similar role so we threw them together. Stata is a lot cheaper than SPSS, people usually seem to like it, and it seems popular for introductory courses. SPSS and Stata are mainly used by biologists and social scientists. They want the easiest way possible to do the sort of standard statistical analyses that are very orthodox in many academic disciplines. (ANOVA, multiple regressions, t- and chi-squared significance tests, etc.). Certain types of scientists, like physicists, computer scientists, and statisticians, often do weirder stuff that doesn't fit into these traditional methods.

If you are working in research, such as economics, public health or politics, STATA seems to be a winner. It has enormous user support in this

type of community. Statistical analysis using Stata is relatively weak on ANOVA and only adequate on factor analysis but extraordinary on regression analysis, complex survey designs, limited dependent variables, epidemiological methods, survival analysis, panel designs, time series, and diagnostics. Although Stata has the smallest development team, all their efforts are focused on the statistical needs of scholars. Looking to the future, Stata may have the strongest collection of advanced statistical procedures…Stata has a command structure that is simple and consistent. The consistency of Stata is impressive. User-developed procedures can be installed over the Internet without leaving Stata…This expandability of Stata is its special strength. The documentation for Stata is excellent. Despite the price it is one of the most complex statistical software on the market. It has code built in ability and is relatively easy to perform a statistical analysis in it.

The IBM SPSS, as being said, is similar to STATA, but it does not all the features STATA have. However, it is more popular in social sciences as STATA, in fact it is the most popular software in social sciences. This is mainly due to its extraordinary simplicity and the best GUI environment which make statistical analysis using SPSS so easy. SPSS is all you need if you can minimize complex data management and if you are not going to do cutting edge statistical analysis. If you only open a statistical program twice a month, SPSS has clear advantages because it is so much like the familiar Excel spreadsheet."

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Mathematical Modeling of the Deposit IFC Strategy under Uncertainty

Mariya Kvasniy[1]

Abstract. Built deposit IFC strategy as a dynamic optimization problem on the parameters of profitability and liquidity. The theory of production functions, differential equations and mathematical games is used. A model is built and the method of realization is developed. To account for the impact of competitive environment Hurwitz criterion proposed use, providing flexibility of decision making. For numerical realization of tasks set up the software in the language of Delphi. Implemented model for financial corporations: Privatbank, Oschadbank and Ukreksimbank.

Keywords: financial corporation deposit strategy, simulation, optimization, production functions, integral-differential equation, Hurwitz criterion.

JEL Classification: C02, C53, G21

1 Introduction

The issue of forming deposit policy of financial corporations in Ukraine neglected. This can be explained by the fact that the demand for banking products far exceeded supply, foreign exchange rate and inflation increased, the resources available were cheap. Interbank lending allowed financial corporations are not particularly worried by the structure of borrowed funds. In terms of financial instability situation has changed: interbank loans decreased markedly reduced deposits, sharpened competition for resources and effective areas of their deployment. This reduced profitability of banking activities, as for the development of financial corporations are forced to look for ways to improve the formulation and implementation of its deposit policy (Kvasniy, 2013). Today the successful operation and expansion of IFC not to raise funds at a lower cost and a higher place, it is necessary to create an effective system of management. To maintain the competitiveness of the financial corporations have to offer all customer new services use various financial instruments to expand activities and improve existing practices. In such circumstances, great importance is the development strategy Financial

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Corporation, including the memorandum deposit policy and tactics for its implementation (Batrakova, 2009).

Deposit Policy Finance Corporation aims to optimize the cost of raising funds in the deposit market conditions for their effective use. This mechanism of realization of interests of the deposit market forms the price to deposit funds. However, the increase in the share of expensive deposit instruments leads to higher interest expenses on the other hand a high proportion of low-resource enhances profitability, but leads to a decrease in liquidity (Bartosh, 2008). For the balance of the deposit multifaceted activities necessary to develop science - based strategies. In developing the strategy, it is important to determine the real position of financial corporations in the deposit market, create goals and objectives deposit policy, to develop a model of behavior and measures for its implementation (Kvasniy, 2013).

In terms of financial instability for the effective deposit policy banks actively use both tangible and intangible resources. Particular weight gains study strategies, which is one of the means of economic and mathematical modeling. The modeling of the deposit is complicated nonlinearity of the loan and deposit activity and influence on her environment, particularly under conditions of incomplete information. Is also not easy interpretation of results because strategic programs of financial corporations confidential and internal and external reporting characterized by significant differences. In this regard, the formation and implementation of policies deposit is always topical and requires constant study (Vasurenko, 2008).

At the present stage of development of the deposit strategies need further improvement, as static and dynamic financial market. In (Kapustyan, 2011) model is built on goodwill and liquidity parameters as linear differential equation with delay, and in the works (Kvasniy, 2010; 2013) proposed a generalization to nonlinear case, particularly in the form of production functions.

The aim of this work is the use of economic and mathematical modeling to improve the processes of formation and correction strategies Financial Corporation to attract deposits under uncertainty. The goal led to the need to analyze factors influencing the rate of growth of deposits; explore features of influence profitability and liquidity in deposit activity; described the possibility of modeling strategies as bank deposits optimization problem based

on production functions and game theory; construct a mathematical model and develop a method of its solution; implement numerical model and build an optimal strategy.

2 Building a mathematical model of the deposit strategy

On the deposit of financial corporations affect the financial and economic environment because of the main factors which include: gross domestic product, unemployment, income, inflation, foreign reserves and exchange rate. Among the microeconomic impact factors should be noted: the actual size of the capital's image bank, the effectiveness of marketing, especially competition policy bank, qualified personnel, including the culture of customer service, technology, range of services, financial capacity to pay for borrowed funds, pricing, stable customer base (Moroz, 2002), (Vasurenko, 2008).

To build strategies deposits commercial banks use economic and mathematical modeling, which is complicated nonlinearity studied processes. Mathematical models build on the integration of economic theories and mathematical methods. In particular, production theory, which argues that the IFC is now on production theory of money and financial institutions, which allows for economic indicators to assess corporation, mathematical game theory and optimization methods and economic theory of production functions (Soroka, 2015).

According determinants of deposit accepted indicators of profit and liquidity. It is assumed that the allocation of resources is only through the deposits, indicating the importance of the inflow of resources for the corporation. To determine liquidity using the formula (1):

$$L_i = \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{\sum_{k=1}^{n} K_{ki}(t)(1 + p_{ki}(t)) + M_i(t)(1 + p_i(t))}{\sum_{d=1}^{m} D_{di}(t)(1 + p_{di}(t))} dt \qquad (1)$$

Where L_i - an indicator of liquidity, reflecting how the loans secured by all of deposit;

$K_{ki}(t)$ - The volume of loans k program issued by the Corporation i at the time t;

$p_{ki}(t)$ - Interest rate loan k program;

$D_{di}(t)$ - Deposits d program, attracted by the Corporation at the time t;

$p_{di}(t)$ – Interest rate deposit d program;

$M_i(t)$ - Corporation i funds placed in the interbank market;

$p_i(t)$ - Interbank interest rate.

Profits of financial corporations characterized as a measure of the efficiency of its operation, the stability that has a positive impact on confidence in the corporation. Consider the rate of return:

$$P_i = \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \left(\sum_{k=1}^{n} K_{ki}(t) p_{ki}(t) + M_i(t) p_i(t) - \sum_{d=1}^{m} D_{dt}(t) p_{di}(t) - Y_i(K(t), D(t)) \right) dt \quad (2)$$

Where P_i - the rate of return financial corporations;

$Y_i(K(t), D(t))$ - The production function Financial Corporation (the cost to implement the credit and deposit activities. To build a strategy deposit of IFC assumes that her condition is characterized by the volume of placed and attracted resources of technology - a production function that expresses the costs arising from the process control on placement and fundraising (Kvasniy, 2010). Production function Cobb-Douglas to take account of the impact of external factors:

$$Y_i(K(t), D(t)) = B_i K_i^{\beta_i}(t) D_i^{1-\beta}(t) \quad (3)$$

Where β - the measure the impact of credit portfolio to total costs;

$1-\beta$ – The measure the impact of the deposit portfolio in the total cost;

B_i – Rate the technological of progress Finance Corporation.

Therefore, activity Financial Corporation to attract deposits can be interpreted as the production function of profit and liquidity:

$$\dot{D}_i = A_i P_i^{\mu_i}(t) L_i^{1-\mu}(t) \qquad (4)$$

Where $\dot{D}_i$ – the deposits change with the change of time;

μ – Measure the impact of profit on capital deposits;

$1-\mu$ – Measure the impact of liquidity on capital deposits;

A_i – Technologies rate of corporation to attract resources.

Build a mathematical model of the financial corporation based on performance (1), (2) and production functions (3), (4) to determine the competitive strategy of attracting deposits under conditions of uncertainty on the basis of management of credit and deposit rates.

The conditions of the functioning model of deposits:

• All financial transactions Financial Corporation, in this model are reduced to financing and fundraising.

• Impact on cash flow management through lending and deposit interest rates.

• The amount of loans and interbank not be greater than the amount received deposits.

• Liquidity is limited below 1.

• Each corporation the amount of borrowed funds equal to the amount of redundancy, the volume of loans and the volume of the interbank market.

• The banking system operates under the condition $\sum_{i=1}^{N} K_i = (1-\alpha)\sum_{i=1}^{N} D_i$ (condition of equilibrium, the amount of offers and demand on the interbank market is equal to 0) (Kvasniy, 2013).

Optimization task will consider the case of restrictions on the rate of profit, the difference between credit and deposit rates:

$$p_{ki} - p_{di} = d_i \qquad (5)$$

Under the above assumptions, we obtain the system parameters and ratios that make up the mathematical model strategy deposit taking financial corporation i in uncertainty at a time t of constraint on the rate of income:

$$\begin{cases} P_i = \dfrac{1}{t_2 - t_1}\int_{t_1}^{t_2}\left(\sum_{k=1}^{n} K_{ki}(t)\,p_{ki}(t) + M_i(t)\,p_i(t) - \sum_{d=1}^{m} D_{dt}(t)\,p_{di}(t) - Y_i(K(t), D(t))\right)dt \\ L_i = \dfrac{1}{t_2 - t_1}\int_{t_1}^{t_2} \dfrac{\sum_{k=1}^{n} K_{ki}(t)(1 + p_{ki}(t)) + M_i(t)(1 + p_i(t))}{\sum_{d=1}^{m} D_{di}(t)(1 + p_{di}(t))}\,dt \\ \dot{D}_i = f(P_i(t), L_i(t)) \\ \dot{D}_i = A_i P_i^{\mu_i}(t) L_i^{1-\mu}(t) \\ M_i(t) = (1-\alpha)D_i(t) - K_i(t) \\ \sum D_i \geq \sum M_i + \sum K_i \\ D_{i-1} \leq D_i \\ L_i \geq 1 \\ p_{ki} - p_{di} = d_i \end{cases} \qquad (6)$$

Where $\dot{D}_i = f(P_i(t), L_i(t)) -$ integral-differential equation;

$f(P_i(t), L_i(t)) -$ IFC production function that describes the activities aimed at attracting deposits;

$\alpha -$ Interest rate reservation inverses value of the money multiplier.

However, the presence of many members of the financial efficiency of the decision of one of them depends on what decision will take others. When choosing a strategy of interest rate financial corporation, consider the range of programs other corporations. In the face of uncertainty about the decision of each individual financial institution is the best strategy to attract resources - slip curve Hurwitz, who recommends a strategy defined by the formula:

$$\max_i \left\{ \eta \min_j a_{ij} + (1-\eta) \max_j a_{ij} \right\}, \quad (7)$$

Where η - the degree of optimism that varies in the range [0, 1]. Moving from minimum to maximum rates and vice versa, you can consider the impact of the environment and make a deposit policy dynamic. Given the specificity of the problem, the solution model (6, 7) is limited to problems of mathematical game theory - finding optimal solutions for symmetric coalition without problem.

3 The numerical model implementation strategy deposit

To implement the proposed mathematical model of the deposit strategy built on defining parameters earnings and liquidity are using a program made in Delphi environment (Kvasniy, 2013).

To build a strategy to attract resources consider credit and deposit market with the first group of three corporations: Privatbank, Oschadbank, Ukreximbank. Denote the initial conditions of numerical model (6, 7) is asking the initial value of deposits, loans, interest rates, reserve rate, rate of return (see tab.1). Since the proposed model will sell for financial corporation from the first group, the average return on assets profitability select the arithmetic mean of the first corporations in 2015 r = 0,95. Reserve requirements are determined by banking legislation and an average of $\alpha = 0.05$ in 2015 (website of the National Bank of Ukraine, 2015).

Table 1 Initial financial performance data, Source: website of the National Bank of Ukraine, 2015

Financial corporation	$D_i(0)$ thous.UAH.	$K_i(0)$ thous.UAH.	$p_{ki}(0)$	$p_{di}(0)$	$p_i(0)$
Privatbank	195 039 214	181 362 098	25%	13%	21%
Oschadbank	108 594 999	69 158 393	23%	11%	21%
Ukreximbank	79 826 722	57 646 651	24%	10%	21%

During testing programs and comparison of statistical data, found that the ratio of IFC technology to attract resources means profits and liquidity A_i = 0.14568, and the rate of technological management of credit and deposit the corporation B_i = 0.09648.

Construct a strategy for fundraising Finance Corporation under uncertainty algorithm:

1. With the program, given the restrictions on the NBU margin starting conditions Financial Corporation, calculate the future lending and deposit rates will increase deposits.
2. Similarly, expect lending and deposit rates to our competitors, based on their starting conditions and regulations of the NBU.
3. Received set interest rates that provide fundraising, Hurwitz and apply criteria are five strategies that are basic, other derivatives. For them, the program calculated deposits, loans and interest rates.
4. Depending on the state of financial management environment has the ability to build a flexible strategy to move from minimum to maximum performance, or vice versa.

As a result of calculations obtained value of deposits, loans and interest rates in six of the forecast period for each Financial Corporation (Figure 1, 2, 3).

t	0	1	2	3	4	5	6
D[t]	195039214	195039214,1	195039339,1	195039453,3	195039561,8	195039669,9	195039789,8
K[t]	181362098	163345341,8	174316356,9	179801918,8	182544751,1	183916218,8	184602009,5
Pk[t]	0,25	0,252924613	0,251282665	0,250522308	0,250155894	0,249975972	0,249886815
Pd[t]	0,13	0,145575953	0,144155443	0,143465269	0,143124918	0,142955889	0,142871660

Figure 1 Forecast of deposits, loans and interest rates for Privatbank, Source: own.

Results of optimization models show that for fundraising Privatbank growth necessary to reduce credit and deposit rates to increase slightly.

t	0	1	2	3	4	5	6
D[t]	79826722	79826722,15	79826836,45	79826950,93	79827065,50	79827180,11	79827362,39
K[t]	57646651	66854879,74	71345187,18	73590395,28	74713053,75	75274437,43	75555215,85
Pk[t]	0,24	0,252924613	0,251282674	0,250522322	0,250155911	0,249975991	0,249886844
Pd[t]	0,1	0,145575953	0,144155451	0,143465282	0,143124932	0,142955907	0,142871688

Figure 2 Forecast of deposits, loans and interest rates for Ukreximbank, Source: own.

Analyzing the results of calculation models for Ukreximbank, it should be noted that the increase in resources can be expected with an increase in the rates of credit and deposit which corresponds to stabilize the financial environment, financial corporations as a significant proportion of foreign clients.

t	0	1	2	3	4	5	6
D[t]	108594999	108594999,1	108595129,3	108595259,7	108595390,2	108595520,7	108595651,3
K[t]	69158393	90948311,73	97056842,30	100111169,5	101638395,1	102402069,9	102783969,3
Pk[t]	0,23	0,252924613	0,251282672	0,250522318	0,250155907	0,249975986	0,249886829
Pd[t]	0,11	0,145575953	0,144155448	0,143465279	0,143124928	0,142955902	0,142871673

Figure 3 Forecast of deposits, loans and interest rates for Oschadbank, Source: own.

Regarding Oschadbank, then this model for the growth of the resource base of the bank should maintain a similar policy Ukreximbank directed to increase deposit and lending rates. This policy is most attractive for the customer and provides a guaranteed result.

4 Construction of optimal strategies

To build a strategy in terms of instability, considering for each financial corporation expected rates to ensure the growth of deposits at maximizing profits and maintaining liquidity, we find the minimum and maximum rates and the criterion of Hurwitz get:

$$p_k = 0{,}250\eta_1 + 0.253(1-\eta_1);\ p_d = 0{,}143\eta_2 + 0{,}146(1-\eta_2);\ \eta_1, \eta_2 \in [0;1]. \quad (8)$$

The bank management has the ability to adjust rates on option depending on the completeness of the information about the state of the financial and economic environment and features of its conduct. When the need for resources, financial corporation η closer to 0 and gets maximum exposure, and when necessary to stimulate the allocation of resources η close to 1, ponds minimal. There are other options when a maximum rate and the other minimum

or intermediate between them. For data (see tab.1) key options expected interest rates presented in table 2.

Table 2 The interest rate based on the criterion of Hurwitz, Source: own.

η	$\eta_1 = 1; \eta_2 = 1$	$\eta_1 = 1; \eta_2 = 0$	$\eta_1 = 0; \eta_2 = 1$	$\eta_1 = 0{,}5; \eta_2 = 0$	$\eta_1 = 0; \eta_2 = 0$
p_k	0,250	0,250	0,253	0,252	0,253
p_d	0,143	0,146	0,143	0,146	0,146

For each proposed set of strategies to calculate the expected volume of deposits and loans and comparable value. Strategy for maximum deposit - average and maximum lending rates (fourth and fifth strategy), our model does not result, and indicates the emergence of negative terms, leading to a decrease, not increase profits. Consider the second strategy, which is the most attractive for the customer: the maximum deposit and minimum credit (see fig.4).

t	0	1	2	3	4	5	6
D[t]	195039214	195039214,1	195039214,2	195039363,3	195039512,8	195039661,8	195039806,3
K[t]	181362098	163345341,7	174316297,8	179801846,4	182544691,7	183916185,2	184602000,8
Pk[t]	0,201	0,252924613	0,251282658	0,250522308	0,250155898	0,249975978	0,249886818
Pd[t]	0,146	0,145575953	0,144155438	0,143465268	0,143124917	0,142955892	0,142871663

Figure 4 Dynamics of Privatbank and allocation of resources with guaranteed strategy, Source: own.

As you can see from the calculations (Figure 4) within a period of six deposits are increasing; Loans decreased in the first period, and only 4 credits exceed the amount of the initial period, while deposit rates are falling slightly, and loans - increased.

When using the strategy: the maximum credit - minimum deposit (Figure 5), which is most interesting for IFC margin deposits and loans are growing more slowly than in the previous strategy, interest rates are slightly increasing.

t	0	1	2	3	4	5	6
D[t]	195039214	195039214,1	195039214,3	195039214,5	195039323,0	195039431,0	195039538,8
K[t]	181362098	119461518,6	108490562,9	146888908,3	122204284,9	109862000,2	147574781,0
Pk[t]	0,253	0,261788535	0,264870039	0,255748519	0,261087980	0,264458068	0,255620873
Pd[t]	0,143	0,151919282	0,153717810	0,147818468	0,151485297	0,153487208	0,147722111

Figure 5 Dynamics of resource allocation and strategy at Privatbank maximum margin, Source: own.

Analyze the results of the numerical calculations in the strategy of minimal credit and deposit rates (Figure 6). Under these conditions, deposit growth is slower than in the previous two cases, and loans behave similarly to the second strategy.

t	0	1	2	3	4	5	6
D[t]	195039214	195039214,1	195039339,0	195039477,1	195039615,3	195039730,2	195039848,8
K[t]	181362098	163345341,7	174316356,9	179801930,1	182544782,3	183916263,0	184602059,7
Pk[t]	0,201	0,252924613	0,251282665	0,250522309	0,250155896	0,249975974	0,249886816
Pd[t]	0,143	0,145575953	0,144155443	0,143465271	0,143124918	0,142955891	0,142871661

Figure 6 Dynamics of Privatbank and resource allocation strategy with minimal credit and deposit rates, Source: own.

After analyzing the numerical results, we have that for the growth of deposits of financial corporation the best strategy of minimum rates as the banking market does not like shocks, but prefer a moderate growth and stability. Thus, the three examples show technology corporations implementation of the proposed model building strategies to attract deposit resources under uncertainty. This model can be used in the Finance Corporation in the development of strategic plans.

5 Conclusions

The numerical implementation of the model-based algorithm proposed solutions and composite applications is not contrary to economic reality. Some differences may be due to the unreliability of the data and computation errors. The model does not account for the entire spectrum of banking operations, but only reflects credit and deposit activities. It should be noted that the only possible qualitative comparison of the strategies a reality. This is due to the inability to obtain reliable data on the decisions of the corporation. Therefore, the conclusions about the real strategy made based on descriptive information.

Choosing the right strategy deposit policy, financial corporation can increase the volume of attracted resources in a short period of time. To select the right strategy should be carried out statistical analysis of retrospective deposits make short-term forecasts for deposits in the near future and determine if there will be no sudden changes in financial and economic sphere. Since the behavior of deposits in conditions of instability are non-stationary, it is necessary to adapt the model to the constantly changing market situation.

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Latent Dirichlet Allocation Models and their Evaluation

Paweł Lula[1]

Abstract. Nowadays Latent Dirichlet Allocation (*LDA*) models introduced in (Blei et al. 2003) are very popular in text analysis. The process of their construction is fully automated by many software tools. Effortlessly statistical packages can generate many versions of *LDA* models which can differ each other significantly. Therefore a need of choice of a proper model is very important. This decision can be made only on the basis of exhaustive analysis of candidate models.
In this paper, after short presentation of Latent Dirichlet Allocation models, several aspects of their evaluation are discussed. Finally, an aggregative approach to *LDA* models evaluation is presented.

Keywords: data analysis, text mining, Latent Dirichlet Allocation, evaluation of *LDA* models.

JEL Classification: C63, C11, C65.

1 Latent Dirichlet Allocation

Latent Dirichlet Allocation (*LDA*) is a statistical model which allows to describe contents of text documents as a mixture of topics. Topics should represent different ideas or aspects of the reality. LDA model was introduced in (Blei et al. 2003).

Let's assume that we have:

- vocabulary $\boldsymbol{V}$ with LV terms:

$$\boldsymbol{V} = \begin{bmatrix} v_1 \\ \dots \\ v_{LV} \end{bmatrix} \tag{1}$$

- corpus $\boldsymbol{D}$ with LD documents:

$$\boldsymbol{D} = \begin{bmatrix} D_1 \\ \dots \\ D_{LD} \end{bmatrix} \tag{2}$$

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- set of topics $\boldsymbol{T}$ with LT topics:

$$\boldsymbol{T} = \begin{bmatrix} t_1 \\ \dots \\ t_{LT} \end{bmatrix} \tag{3}$$

- document-topic matrix $\boldsymbol{\Theta}$ with probabilities of appearance of j-th topic in the i-th document:

$$\boldsymbol{\Theta} = \begin{bmatrix} \theta_{1,1} & \cdots & \theta_{1,LT} \\ \cdots & \cdots & \cdots \\ \theta_{LD,1} & \cdots & \theta_{LD,LT} \end{bmatrix} \tag{4}$$

- topic-term matrix $\boldsymbol{\Phi}$ used for topic's definition (every topic is defined by distribution over words). Element $\phi_{i,j}$ can be interpreted as a probability of occurring of j-th term in the i-th topic:

$$\boldsymbol{\Phi} = \begin{bmatrix} \phi_{1,1} & \cdots & \phi_{1,LV} \\ \cdots & \cdots & \cdots \\ \phi_{LT,1} & \cdots & \phi_{LT,LV} \end{bmatrix} \tag{5}$$

Let D_i be the i-th document in the corpus $\boldsymbol{D}$. It can be considered as a string comprised of words. We can assume that $w_{i,j}$ is the j-th word in the D_i document. And that $z_{i,j}$ is the most likely topic for this word. Thanks to generative character of the *LDA* model, the corpus $\boldsymbol{D}$ can be created according to the following schema (Heinrich 2004):

corpus generation according to LDA model
choose LD # LD – number of documents in a corpus
for all $i \in [1, LD]$ do
    choose $len(D_i)$ # number of words in the document D_i
    for all $j \in [1, len(D_i)]$ # for every term in the document D_i
        choose topic id: $z_{i,j} \sim Mult([\theta_{i,1}, \theta_{i,2}, \dots, \theta_{i,LT}])$
        choose term: $w_{i,j} \sim Mult([\phi_{z_{i,j},1}, \phi_{z_{i,j},2}, \dots, \phi_{z_{i,j},LV}])$
        add $w_{i,j}$ to the D_i document
    end for
end for

In the process of construction of the Latent Dirichlet Allocation model prior knowledge is used which concerns two aspects: topic description and definition of document structure. Both these issues are defined by probability distributions.

Topics are defined by specifying the distribution over words from a given vocabulary. For this purpose the Dirichlet distribution with parameter

$\boldsymbol{\beta} = [\beta_1, \beta_2, \ldots, \beta_{LV}]$ is used. The $Dir(\boldsymbol{\beta})$ distribution serves for matrix $\boldsymbol{\Phi}$ generation. This process can be presented as follows:

generation of $\boldsymbol{\Phi}$ matrix (topic-term matrix)
for all $i \in [1, LT]$ do # LT – number of topics
    # generation the i-th row of the matrix $\boldsymbol{\Phi}$ (definition of the i-th topic)
    choose: $[\phi_{i,1}, \phi_{i,2}, \ldots, \phi_{i,LV}] \sim Dir([\beta_1, \beta_2, \ldots, \beta_{LV}])$
end for

Document structure is defined by Dirichlet distribution with parameter $\boldsymbol{\alpha} = [\alpha_1, \alpha_2, \ldots, \alpha_{LT}]$. Information concerning document structure are stored in the matrix $\boldsymbol{\Theta}$:

generation of $\boldsymbol{\Theta}$ matrix (document-topic matrix)
for all $i \in [1, LD]$ do # LD – number of documents
    # generation of the i-th row of the matrix $\boldsymbol{\Theta}$ (definition of the i-th document)
    choose: $[\theta_{i,1}, \theta_{i,2}, \ldots, \theta_{i,LT}] \sim Dir([\alpha_1, \alpha_2, \ldots, \alpha_{LT}])$
end for

In both cases presented above symmetric Dirichlet distribution can be used. In this case all elements of $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ vectors are equal.

Using the Bayesian approach for model estimation the prior knowledge (expressed by $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ parameters) is aggregated with results of dataset analysis during estimation process. As a result values of parameters $\boldsymbol{\Theta}$ and $\boldsymbol{\Phi}$ are obtained. Usually collapsed Gibbs sampling method is used for this purpose (Heinrich 2004).

2 LDA models evaluation

There are two main forms of LDA models evaluations:

3) human assessment of model's results,
4) evaluation based on measures calculated during simulation experiments.

Main features of both types of evaluation are gathered in the Table 1.

Table 1 Features of human and automatic evaluation of LDA models, Source: own.

	Human evaluation	**Automatic evaluation**
Advantages	• multifaceted, • based on external expert knowledge.	• objective, based on well-defined indicators, • repeatable.

Disadvantages	• subjective, • prone to errors, • based on rules difficult for identification and explicit expression.	• difficult for conducting at the semantic level.

3 Measures of quality for LDA models

The list of measures useful for LDA model evaluation contains among others: likelihood, perplexity, measures of topics' diversity and measures of topics' coherence. All these indicators are presented in the current section of the paper. Next an aggregative measure for model evaluation is proposed.

3.1 Likelihood function

Likelihood function calculated for a given dataset returns a probability that this dataset would be generated by the model.

Let D_d be a document composed of $len(D_d)$ words:

$$D_d = \{w_{\mathrm{d},1}, w_{\mathrm{d},2}, \dots, w_{d,i-1}, w_{d,i}, w_{d,i+1}, \dots, w_{d,len(D_d)-1}, w_{d,len(D_d)}\} \tag{6}$$

with every word an appropriate topic identifier is assigned:

$$Z_d = \{z_{\mathrm{d},1}, z_{\mathrm{d},2}, \dots, z_{d,i-1}, z_{d,i}, z_{d,i+1}, \dots, z_{d,len(D_d)-1}, z_{d,len(D_d)}\} \tag{7}$$

Then the probability that the term $w_{d,j}$ is of value w^* can be expressed as:

$$p(w_{d,j} = w^* | \boldsymbol{\Theta}_d, \boldsymbol{\Phi}) = \left(\sum_{t=1}^{LT} p(w_{d,j} = w^* | \boldsymbol{\Phi}_t) p(z_{d,j} = z_t | \boldsymbol{\Theta}_d) \right) p(\boldsymbol{\Theta}_d) p(\boldsymbol{\Phi}) \tag{8}$$

For calculating the value of likelihood function for the whole document the following formula can be used:

$$p(\boldsymbol{w}_d = \boldsymbol{w}^* | \boldsymbol{\Theta}_d, \boldsymbol{\Phi}) = \left(\prod_{j=1}^{len(D_d)} \sum_{t=1}^{LT} p(w_{d,j} = w^* | \boldsymbol{\Phi}_t) p(z_{d,j} = z_t | \boldsymbol{\Theta}_d) \right) p(\boldsymbol{\Theta}_d) p(\boldsymbol{\Phi}) \tag{9}$$

To eliminate parameters $\boldsymbol{\Theta}_d$ and $\boldsymbol{\Phi}$ from the formula (5.86) proper marginal distributions should be defined:

$$p(\boldsymbol{w}_d = \boldsymbol{w}^*) = \iint \left(\prod_{j=1}^{len(D_d)} \sum_{t=1}^{LT} p(w_{d,j} = w^* | \Phi_t) p(z_{d,j} = z_t | \boldsymbol{\Theta}_d) \right) p(\boldsymbol{\Theta}_d) p(\boldsymbol{\Phi}) d\boldsymbol{\Theta}_d d\boldsymbol{\Phi} \qquad (10)$$

The likelihood function can also be calculated for the whole corpus. Then the following expression can be helpful:

$$p(\boldsymbol{D}) = \prod_{d=1}^{LD} p(\boldsymbol{w}_d = \boldsymbol{w}^*) \qquad (11)$$

Likelihood function plays crucial role in maximum likelihood estimation which returns parameters corresponding to maximum value of it. Except that likelihood may play important role in evaluation of *LDA* models, because a greater value of likelihood calculated for a given dataset warrants better ability to model real phenomena.

3.2 Perplexity

Perplexity can be defined as the inverse of geometric mean of per-word likelihood for a given dataset. It can be expressed by the formula (Grün & Hornik 2011):

$$perplexity(\boldsymbol{D}) = \sqrt[LW]{\frac{1}{\prod_{i=1}^{LW} p(w_i)}} \qquad (3)$$

where LW is a number of words in a dataset. Because of necessity of calculation of the product of small values of $p(w_i)$ it is desirable to transform **Chyba! Nenalezen zdroj odkazů.** formula:

$$perplexity(\boldsymbol{D}) = \sqrt[LW]{\frac{1}{\prod_{i=1}^{LW} p(w_i)}} = exp\left(ln\left(\sqrt[LW]{\frac{1}{\prod_{i=1}^{LW} p(w_i)}} \right) \right) =$$

$$perplexity(\boldsymbol{D}) = \sqrt[LW]{\frac{1}{\prod_{i=1}^{LW} p(w_i)}} = exp\left(ln\left(\sqrt[LW]{\frac{1}{\prod_{i=1}^{LW} p(w_i)}} \right) \right) =$$

$$= exp\left(-\frac{1}{LW} \sum_{i=1}^{LW} ln(p(w_i)) \right) \qquad (43)$$

A lower perplexity for test dataset indicates better generalization ability of a model. In order to check the model's ability to proper behaviour for unseen

data, usually perplexity is calculated for held-out dataset which was not used during model estimation.

3.3 Topics diversity

During construction process of LDA models we should pursue to find topics varying each other and simultaneously internally coherent. We should maximize both topic diversity and topic coherence.

It is possible to indicate two main approaches to evaluate topic diversity:

- comparison of the words' distributions for two topics,
- co-occurrence of topics in documents.

Comparison of the words distributions for analysed topics is the first of them.

Let's assume that $p(x)$ and $q(x)$ are distributions of words in two different topics. Then Kullback-Leibler divergence can be used for of them:

$$d_{KL}(p,q) = \sum_i p(x_i) log\left(\frac{p(x_i)}{q(x_i)}\right) \tag{5}$$

Considering that KL-divergence is not symmetric, the mean value of $d_{KL}(p,q)$ and $d_{KL}(q,p)$ is calculated:

$$d_{\overline{KL}}(p,q) = \frac{d_{KL}(p,q) + d_{KL}(q,p)}{2} \tag{156}$$

A greater value of the mean KL-divergence indicate greater topics diversity.

Among other measures of distance between distributions, the Bhattacharyya distance can be mentioned:

$$d_B(p,q) = -ln\big(BC(p,q)\big) \tag{7}$$

where $BC(p,q)$ is called the Bhattacharyya coefficient and is defined as:

$$BC(p,q) = \sum_i \sqrt{p(x_i)q(x_i)} \tag{17}$$

The Bhattacharyya coefficient can be interpreted as a measure of overlapping of two distributions. This measure is normalized to the range from 0 (no overlapping of distributions) to 1 (identify of distributions).

The second approach of topics' comparison is based on analysis of co-occurrence of topics in different documents. A measure of similarity of i-th and j-th topics can be defined as:

$$sim_{i,j} = \frac{\sum_{d=1}^{LD} n_{d,i} n_{d,j}}{\sqrt{\sum_{d=1}^{LD} n_{d,i}^2} \sqrt{\sum_{d=1}^{LD} n_{d,j}^2}} \tag{18}$$

where $n_{d,i}$ is a number of words in d-th document which were assigned to i-th topic.

3.4 Topic coherence

The automatic evaluation of topic's coherence is based on the list of n the most probable words in the topic:

$$\boldsymbol{w}_{TOP} = w_1, w_2, \ldots, w_n \tag{19}$$

Then coherence can be defined as a sum of association strength between every pair of word from a top list:

$$coherence(t) = \sum_{i=2}^{n} \sum_{j=1}^{n-2} association\left(w_i^{(t)}, w_j^{(t)}\right) \tag{8}$$

where $association\left(w_i, w_j\right)$ is a measure of association between words w_i and w_j. The measure of $association\left(w_i, w_j\right)$ can have *extrinsic* or *intrinsic* character.

The extrinsic measure of topic coherence was proposed in (Newman et al. 2010) where the following formula was introduced:

$$coherence(t) = \sum_{i=2}^{n} \sum_{j=1}^{n-2} \log \frac{p\left(w_i^{(t)}, w_j^{(t)}\right)}{p\left(w_i^{(t)}\right) p\left(w_j^{(t)}\right)} \tag{21}$$

where:

$$p\left(w_i^{(t)}\right) = \frac{D_{Wikipedia}\left(w_i^{(t)}\right)}{D_{Wikipedia}} \tag{22}$$

and:

$$p(w_i^{(t)})p(w_j^{(t)}) = \frac{D_{Wikipedia}(w_i^{(t)}, w_j^{(t)})}{D_{Wikipedia}} \tag{9}$$

assuming that:

- $D_{Wikipedia}$ – number of documents in *Wikipedia*,
- $D_{Wikipedia}\left(w_i^{(t)}\right)$ – number of documents in *Wikipedia* containing at least one occurrence of $w_i^{(t)}$,
- $D_{Wikipedia}\left(w_i^{(t)}, w_j^{(t)}\right)$ – the number of documents in *Wikipedia* containing containing at least one occurrence of $w_i^{(t)}$ and at least one occurrence of $w_j^{(t)}$.

The intrinsic measure of topic coherence was proposed in (Mimno et al. 2011). The idea of the measure is very similar to the formula described above. In this approach instead of *Wikipedia*, a current corpus of documents is used for coherence evaluation:

$$coherence(t) = \sum_{i=2}^{n}\sum_{j=1}^{n-2} \log\frac{D(w_i^{(t)}, w_j^{(t)}) + 1}{D(w_i^{(t)})} \tag{24}$$

3.5 Aggregated measure of the LDA model quality

Using the approach presented in this paper several quality indicators for *LDA* models can be calculated. Different aspects of quality expressed by indicators can vary in significance which can be specified by weights associated with indicators. All these data form input matrix which can be further processed by multi-criteria methods. The form of the matrix is presented in Table 2.

Table 2 The input data for multi-criteria analysis, Source: own.

Indicators of *LDA* quality		Q_1	Q_2	Q_3	...	Q_P
Weights		w_1	w_1	w_1	...	w_1
Models	M_1	$q_{1,1}$	$q_{1,1}$	$q_{1,1}$	⋯	$q_{1,1}$
	M_2	$q_{1,1}$	$q_{1,1}$	$q_{1,1}$	⋯	$q_{1,1}$
	...	...	...	...	...	...
	M_T	$q_{1,1}$	$q_{1,1}$	$q_{1,1}$	⋯	$q_{1,1}$

Thanks to multi-criteria analysis, by means of proper algorithms different *LDA* models can be ordered in accordance with established criteria. The issue is widely discussed in literature (e.g. (Greco 2006) or (Trzaskalik 2013)).

The approach presented in the paper was used for evaluation of abstracts of PhD thesis prepared in Polish language at the Cracow University of Economics in the period 2010-2015. The corpus was composed of 159 documents. First stemming process was performed with the help of *Morfologik* system[1]. Next several *LDA* models were prepared using *topicmodels*[2] packet for *R* system. For every model the analysis of likelihood, perplexity, topic diversity and topic coherence was performed. Next an aggregated quality measure was calculated with Hellwig development pattern method (Hellwig 1968). As a result the *LDA* model with six topics was chosen.

4 Conclusions

Unsupervised character of Latent Direchlet Allocation models causes that the process of their evaluation can be difficult and ambiguous. The approach presented in the paper tries to take into account different aspects of model's quality and to build aggregative measure of model assessment. Experiments conducted during research shows that the method presented here can be promising.

Acknowledgements

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Objective Analysis of the Banking Sector with the Use of Artificial Intelligence

Melnyk Nadiia[1]

Abstract. Development of the banking sector of the economy has led to the emergence of problems high-quality and accurate analysis of the results of their activities. Based on the structure of commercial banks and the information content of statements of these institutions are chosen or developed methodology of analysis and selection of the information with minimal risk of loss. All these advantages form the basis of intelligent system using artificial intelligence methods.

Keywords: financial-credit market, PCA, neural networks, factor analysis, systems.

JEL Classification: C61, C63, G21

1 Introduction

Banks, as members of the financial-credit market as a result of its activities form the documentation for reporting and further decision making. As you know, the results of operations of commercial Bank are characterized by a number of characteristics. When a large set of such characteristics arises the problem of identifying influence relations between these characteristics of the researched object, so you need to implement the compression information, i.e. description of the studied object more aggregated indicators, the so-called "main components" that are included in the basis of factor analysis. This method is used to research and calculate the impact factors on your final average.

The method of factor analysis is to describe the set off characteristics studied, and replacing them with a smaller number of bigger information variables. It is a factor analysis divided into two subspecies: forward and reverse. Direct view exists when the final figure is divided into components. To reverse type typical situation where the components are combined into a single summary indicator.

The main feature of factor analysis is to identify objectively existing factors that affect the behavior of the object. The authors of the basic concepts

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of factor analysis is mainly American and English scientists

Gradually increasing interest in these methods and in the countries of continental Europe. Currently, the literature on this subject can be found works by German, French, Italian, Swiss, Spanish and other scientists, while the number of studies is smaller in comparison with researchers in Anglo-Saxon countries.

2 The analysis of banking information using methods of financial analysis

An important methodological issue in the analysis of results of activity of banking institutions is the study and measurement of influence of factors on the number of studied economic indicators. Without a deep and comprehensive study of the factors it is impossible to draw reliable conclusions about the results of activities to identify the scope of the organization, justified plans and management decisions.

The attractiveness of this method is that it allows you to put into circulation and it is useful to apply a large amount of source statistics. It is known that the majority of scientists trying to investigate a particular problem entirely rely on a huge amount of information. But to analyze this amount of information is very difficult. Thus there is a need for compression to a real size by selecting the most significant and minor rejection. It is when there is a need to limit the number of variables and used factor analysis. Moreover, the application of traditional methods of socio-economic analysis, usually compression occurs by reducing the number of investigated parameters logically justified by selecting only the necessary information. But this way you can lose a lot of useful information that, at first glance, this seems. So, in this case the quality of the study will depend on the experience of the researcher. At the same time, the use of factor analysis reduces this threat. With some complex mathematical procedures parameters divided into groups so that we can consider all the factors that allow to describe briefly study an array of numbers. As mentioned above, the analysis of socio-economic phenomena and processes researcher faces the multidimensionality of their description, that the need to take into account in the analysis of a large number of parameters (parameters or characteristics). Many of these features can be interconnected and largely duplicate one another. At the same time often features only

indirectly reflect the most important but intractable direct observation and measurement of internal, hidden properties phenomena. Thus, based on the data describing the results of the financial institution researcher can conclude the efficiency of individual units of the structure and the need to raise additional financing facilities in order to increase profitability. Only a large set of directly measurable attributes allows to compare the indicators for functioning and their influence on the final result of the Bank's activities.

Any analysis according to the definition of the term, implies some variant of the dismemberment of a whole into component parts with further study as the elements of dismemberment, and relationships between them.

The subject financial analysis is financial resources, their flows and transformation of the latter in the time domain. The main objective of financial analysis is identifying and studying the main factors of the financial activities of enterprises, their weight and interaction to search for existing reserves and new ways of its efficient solution. The choice of certain directions and instruments of research depends on the goals of research and on present information and the level of its reliability.

Conventionally currently allocate seven basic methods of financial analysis: horizontal analysis; vertical analysis; trend analysis; Analysis by financial ratios; comparative analysis; analysis of the main components; factor analysis.

To address the analysis of financial performance in the banking sector, I propose to apply the method of principal components analysis and factor analysis, as they are very informative and provide objective information that can be directly used in systems management decisions. In general, these two methods of analysis are interrelated and complementary. Currently, their solution is used quite tradoc statistical procedure based on the canonical scenario of the vector of unknown diagonal elements of the covariance matrix. This principal component analysis (PCA) and factor analysis (FA) are considered as two separate problems with separate productions.

For example, in analyzing the marks obtained at several scales, the researcher notices that they are similar and have high correlation coefficient, it can assume that there is some latent variable, which may explain the similarity of the estimates. This latent variable is called a factor. This factor affects many other variables, which leads us to the possibility and necessity to distinguish it

as the most General, that is, one that is of the highest order.

To identify the most important factors and, as a result, factor structure, it is most expedient to apply the method of principal components analysis. The essence of this method is to replace correlationing components not correlationing factors. Another important characteristic of the method is the ability to restrict the most informative principal components and exclude those from the analysis, which simplifies the interpretation of the results.

Essentially the method is the selection of a new orthogonal coordinate system in the observation space. As the first main component choose the direction along which the array of observations have the largest variance.

Every component chosen from the condition of maximizing the proportion of variance that is left along it, supplemented by the condition of orthogonality to all previously selected components. With the increase in the number of the component will decrease the associated part of the total variance.

The number of components is determined largely subjectively on the basis of understanding what is the amount of the total variance of the corresponding random variability reflects measurement error, the effects of uncontrolled random factors and the like.

3 The technique of factor analysis

The main objective method of principal component is an extract from the data the required information, depending on the nature of problem. These may include the information we need, they may even be redundant. However, in some cases, information on the data cannot be.

Data unit characterized by the number of samples and variables, which is important for the successful extraction of information. These always (or almost always) contain unwanted component is called noise. The nature of this noise may be different, but in many cases, the noise - this is a piece of data that does not contain the required information. What is considered noise, and that - the information always solved taking into account the objectives and methods used to achieve it.

Noise and redundancy in data necessarily manifest itself through correlations between variables. Errors in data can lead to not systematic and random relationships between variables. The concept of the effective rank and

hidden, latent variables, whose number is this ranking is an important concept in the method of principal components.

An important advantage of this method is that it is the only mathematically reasonable method of factor analysis.

Factor analysis requires no a priori division of variables on the dependent and independent, as all variables in it are treated as equal. The task of factor analysis is to determine the number, the concept and nature of the most significant and independent functional characteristics of the phenomenon.

A significant factor analysis distinguishing feature is the simultaneous study of a large number of interrelated variables. It does not require the assumption of invariance of all other conditions common to many other methods of statistical analysis. This factor analysis is a valuable tool to study the phenomenon in all its various real relationships.

The practical implementation of factor analysis begins by verifying its conditions. Among the mandatory conditions for factor analysis are:

- All signs must be quantitative.
- The number of signs should be twice the number of variables.
- The sample must be homogeneous.
- Output variables must be distributed symmetrically.
- Factor analysis is carried out on correlating variables.

In the analysis of one factor combined correlated highly interconnected variables resulting redistribution of variance between the components and the maximum out simple visual structure factors. This procedure also reveals the latent variables is especially important in the analysis of social representations and values.

An important factor can be considered a very real limitations on the measurability of tasks that are specific to existing statistical methods, as the task of financial analysis in most cases are significant large-scale data volumes.

In the current formulation of the problem PCA and FA are reduced to approximation with sufficient accuracy for practical implementation of the vector, as a result of linear transformation vector of smaller dimension.

Going beyond the classical objectives of factor analysis (including the use of neural networks to implement it), put the goal of transformation vectors

represent implementations of object initially set in n-dimensional space implementations (with certain accuracy) representing vectors in m-dimensional cramped space implementations, where m <n.

And, provided an opportunity to direct conversion of initial signs of symptoms in less space dimension and inverse conversion factors in the initial symptoms. Additional required to provide certain qualitative factors highlighted the meaning of the content features vectors-implementations. This application of neural networks not become significant spread due to learning difficulties last, but implementation approach is rather trivial.

Solving the problem of factor analysis for a limited number of factors that are set with sufficient accuracy is possible if the transition to nonlinear transformation that involves changing some principles and conditions of the method. In particular, depending on the factors to consider input from the features of the object become nonlinear nature that can change the interpretation of certain factors in the different parts of space.

To perform nonlinear factor analysis variant of a two-stage neural network structure. As a second stage neural network uses a linear version of it, and Correction of input variables to the appropriate values approximated rely on approximation of neural networks, which should be characterized by good prognostic properties.

It is assumed that as a result of approximating neural network based on linear neural network can provide $xi^* \approx xi^{**}$

As the main result of the analysis for which is used the neural network shown in Fig.1, is the matrix of factor loadings that takes the form (Fig. 2).

Analyzing the matrix of factor loadings (Figure 2), it is easy to see that in the case of each individual factor is crucial to the initial symptoms, sensitivity coefficients which are the smallest and most dependent on the characteristics, sensitivity coefficients which are the largest. Note, however, that the provision of content to individual factors is rather subjective procedure that poorly formalization.

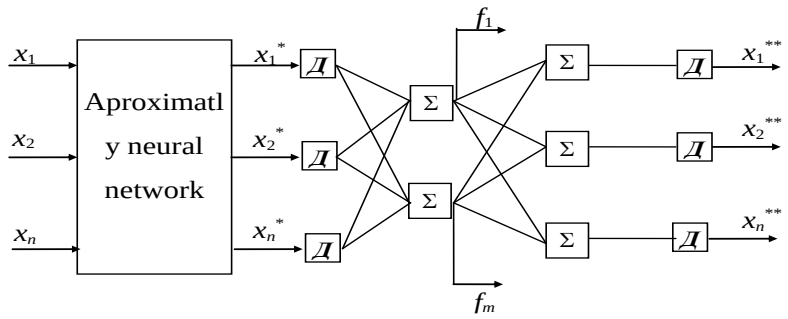

Figure 1 Neural network nonlinear factor analysis

x\f	f_1	f_2			f_m
x_1	$\frac{\partial f_1}{\partial x_1}$	$\frac{\partial f_2}{\partial x_1}$	.	.	$\frac{\partial f_m}{\partial x_1}$
x_2	$\frac{\partial f_1}{\partial x_2}$	$\frac{\partial f_2}{\partial x_2}$	.	.	$\frac{\partial f_m}{\partial x_2}$
.	.	.	.	.	.
x_n	$\frac{\partial f_1}{\partial x_n}$	$\frac{\partial f_2}{\partial x_n}$	.	.	$\frac{\partial f_m}{\partial x_n}$

Figure 2 The matrix of factor loadings.

4 Application of artificial intelligence tools to analyze the performance of the Bank

All banking institutions describing their activities using spreadsheets containing certain bank parameters and structural units within the structure of the bank. Throughout activity occurs analyst with the problem of accumulation of this information. For the analysis of all the results of the analyst takes a lot of time, and the results of this analysis are not always accurate. Therefore, in our opinion, this problem can be solved using factor and cluster analysis based on ANN. To identify the most influential factors allow the analyst to focus only on those factors that narrow the error. As our research tool for you Make the principal components method.

We apply this method to solve the problem multiparameter analysis of banking facilities, including the results of the structural units of the Savings Bank of Ukraine. We have the sample containing 22 and 321 parameter block unit for further location. These data are original and have been granted the JSC

"Oshadnyu Bank of Ukraine". All data in the record file of the training data. Given the nature of the networks machine geometric transformations at training a number of vectors corresponding to different classes must be comparable. We train the neural network (NN) func*net Express on a sample consisting of the elements in prediction mode, that with a continuous output that seems real number.

Determine the input features that have the greatest impact on output. For this we use AANM the "narrow neck", the inputs and outputs of which are input attribute vector of the training set (321 values). The inputs and outputs are asking all 22 option, the number of neurons - 22. Having taught AANM, get a table principal components (Table 1).

Table 1 The main components

	MC1	MC2	MC3	…	MC20	MC21	MC22
1	0.02938	0.0200959	-0.016371	…	0.0011101	-0.006113	9.2576507
2	0.12737	0.0393157	0.0016447	…	-0.005931	-0.003663	0.0051903
3	-0.063853	0.0086865	-0.006174	…	-0.002545	0.0012647	-6.465866
4	0.0130298	0.0263430	0.021245	…	0.0021789	-0.001949	-0.001881
5	-0.039751	0.0114491	0.0059215	…	0.0022053	0.0025662	0.002012
6	-0.085480	0.0060884	1.536271	…	-0.001351	7.2491893	-9.573887
7	-0.079841	0.0054470	0.0069030	…	-8.348172	-0.005176	-0.002264
8	0.0605202	0.0050442	-0.025981	…	0.0159642	-0.003338	-4.625342
9	-0.065985	0.0084522	0.0134051	…	9.6821919	0.0015630	-1.631733
10	0.0276565	0.0041397	-0.031900	…	0.0076252	0.0041869	-6.549359
…	…	…	…	…	…	…	
320	0.6689602	-0.010005	-3.665824	…	-0.002442	-2.599631	0.0015084
321	0.3568843	0.0262296	0.0198348	…	0.0067760	-4.810809	-0.002900

The main components with the highest relative dispersion having the greatest influence on the formation of the final result of all structures in general.

We form the following table, where the inputs are the main components of that obtained in the previous autoassociative network as well as the initial inputs outputs using the same vectors. Load table formed in the training data and test data to form a matrix consisting of a single matrix with the first row and zero matrix of 22 columns (Table 2). All tables before loading into the system are formatted in MS Excel. Training undertaken on the training data (Fig.3) application – test data (Fig.4). In the application mode for the last neural network we use a test sample.

Table 2 Matrix for test data

	1	2	3	…	22	23	24	25	…	44
1	0	0	0	…	0	0	0	0	…	0
2	1	0	0	…	0	0	0	0	…	0
3	0	1	0	…	0	0	0	0	…	0
4	0	0	1	…	0	0	0	0	…	0
5	0	0	0	…	0	0	0	0	…	0
…	…	…	…	…	…	…	…	…	…	…
22	0	0	0	…	0	0	0	0	…	0
23	0	0	0	…	1	0	0	0	…	0

For further analysis use the data contained from 23 to 44 column of the resulting matrix (table 3).

Table 3 Results matrix

	1	2	3	4	…	22
1	75052.39	16993.3	5567.752	15891014	…	3960.827
2	28152.2	9895.799	13550.74	867206.4	…	125250.9
3	71421.48	28717.36	26970.48	11024399	…	6258.488
4	358422.4	40663.64	18162.84	33990.84	…	10310.35
5	102429.2	62600.04	7042.57	10890732	…	9842.483
…	…	…	…	…	…	…
22	542253	8741.071	6409.995	3537287	…	7016.088

An analysis of the results using spreadsheet software Microsoft Excel, received options, the results of which most affect the entire institution. This technique is based on the allocation of dominant parameters for each of the main components in descending order.

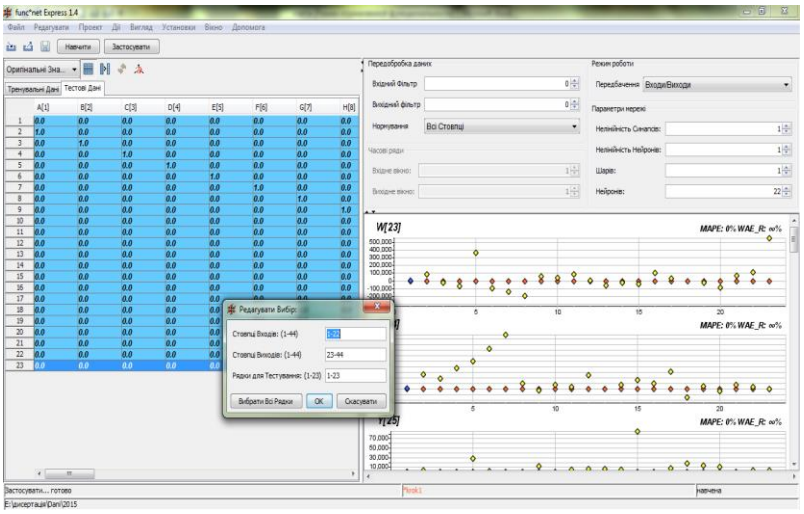

Figure 3 Application to test data

Therefore, the 1st factor - is the first major component (100%), affecting "Cashless payments of individuals for goods, services and other transfers," "demand deposits of individuals" and "Remaining operating cash in offices of commercial banks at the end reporting period". This comparison of the results with appropriate parameters is carried out for all major components.

5 Conclusion

This result helps the analyst to focus when analyzing the results of each branch on the three parameters and identify dominant and problematic branches throughout the financial and credit institution.

The same method of use and the rest of the factors determining their impact, as the decay, the final results of all accountable institutions. Therefore, increased attention to the impact parameter analysis found better analytics will assess the condition of the facility and the time to take appropriate measures to eliminate shortcomings.

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The Impact of Neatness of Salespersons and Point of Purchase to Sales Efficiency

Gozdana Miglič[1], Karmen Kosec[2]

Abstract. Relax Turizem is one of seven subsidiaries of the Relax business group. The company developed a system of their own business units where touristic products (holidays and trips) are sold at the place of purchase. The decision to develop their own sales network was based on the presumption that the number and the quality of sales in their own sales units would be higher due to better neatness of the place of purchase and better qualified sellers. To examine this presumption, there was survey conducted in all Slovene units of Relax Turizem in 2013. Considering the assumption that efficiency is influenced by different elements, the survey tried to determine the impact of neatness of the place of purchase and salespersons on the sales efficiency. The results obtained showed a strong level of correlation between the external and internal factors of neatness of the place of purchase and sales efficiency. Empirical data also demonstrate a strong level of correlation between sales efficiency and salesperson's external (verbal and not-verbal communication) and internal neatness (image impression).

Keywords: buyers, efficiency, impression management, neatness, place of purchase, salesperson

JEL Classification: J24, L15, M53

1 Background information

Relax Company was registered in 1990 as a limited liability company and TOURISM as a basic activity. In 1995 the Relax company joined the International Air Transport Association (IATA) and through AMADEUS (central booking system) connected into the international booking system for selling airplane tickets. In 1999 the Relax Company became the second largest Slovenian tourist agency. In 2001 the company was awarded the ISO 9001/2000 quality certificate and the third place GAZELA award for a growing company. In 2002 Relax began its internationalisation process. The company established subsidiaries in Czech Republic (Brno and Ostrava), Serbia (Belgrade and New Belgrade), Croatia (Zagreb) and the Netherlands (Rotterdam). The same year the company started the project of establishing an

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above-standard coach rolling stock. Today the Relax business group has four subsidiaries in Slovenia (Relax Turizem, Relax Trans, My last minute centre, and Adved – legal affairs) and one subsidiary in each of the following countries: Serbia, Czech Republic, Croatia, and the Netherlands.

Today Relax Turizem is one of seven subsidiaries of the Relax business group. In 2012 Relax Turizem was restructured from a limited liability company into a joint-stock company. The largest share of the company's turnover represents the sale of its own holidays and travels. Within the Relax business group Relax Turizem has the highest turnover and operates exclusively on the Slovenian market with its own standardised products in the field of holidays and trips. Relax Turizem invests approximately 4% of its net turnover into promotion. Along the subagent network (other tourist agencies sell its tourist products) the company has a very well developed network of 23 own business units where the sale at the place of purchase takes place and two business units for telephone and online sales.

A place of business or a place of purchase is a critical point of every organization because at this place contacts with customers are being made at the moment they decide to purchase. Since this is the most critical point that directly influences the success of the organisation, Relax Turizem conducted a survey that was oriented at studying this aspect.

The purpose of this paper is to summarise a part of the findings of the survey that was conducted at Relax Turizem's places of purchase.

2 Introduction

Companies involved in sales use different approaches to attract the buyers, for example good price, special offer and quality of products or service. A specific way to attract customers is represented by a convenient form of purchase. One of these forms is also purchase at the place of purchase.

The place of purchase is a profit cell bound to make profit by selling the products. The place of purchase is represented by:

- Employees who form the plan of the place of purchase;
- The room that is defined as the place of purchase;
- The products that the employees must sell at the place of purchase (Gostenčnik, 2005).

A potential buyer visits the place of purchase with specific prior information on the basis of which they form their expectations. With regard to the higher percentage of purchase decisions, Šulak (1987) said that through personal sales we can perform several functions of promotional sales in one contact: informing, reminding, instructing, encouraging, persuading, promising, and suggesting. Tracy (1997) says that the biggest impact of personal sale is in the phase of purchase and less in the pre- and post-purchase phase where the impact of advertising is substantially bigger. The purpose of the place of purchase is to bring the offer closer to the buyer with intent to sell as many products as possible, and, to use professionally, during the sale, the marketing mix with emphasis on communication mix, while focusing especially on the communication instrument of personal sale (Kotler, Wang, Saunders, and Armstrong, 2006).

Among the advantages of sales activity at the place of purchase Douglas and Craig (1995) list bringing the offer closer to the buyers and adapting it to the buyers, the possibility of tailoring the offer to the interests and needs of local buyers, the possibility of efficient inclusion of the local media to further sales, and personal contact with the local buyers. Among the disadvantages of activities at the place of purchase Douglas and Craig (1995) list the high cost of running a business unit and the increased difficulty of training and more demanding control of the employees at the dislocated units.

Companies have to know how to attract and persuade the potential buyer to purchase their product or service. To succeed in sales high-quality offers and reasonable prices are not enough. Much of the success depends also on the location, external and internal neatness and attractiveness of the place of purchase (Brezovec, 2000). In addition to this, success depends on the salespersons' ability to keep the buyers interested for a longer time (Sypniewska, 2013). The tourist industry is frequently referred to as selling the invisible. If we give it a thought, we see that we truly sell dreams and expectations. A buyer who purchases a travel package in a tourist agency actually does not know what he bought. He made a decision based on photographs in the catalogue and the salesperson's recommendation. This means there has to be a great deal of confidence in the salesperson who recommended the holidays to the buyer. Here we can speak of salesperson's credibility, his integrity and popularity (Swan, Bowers and Richardson, 1999). Success in marketing services largely depends on popularity and integrity

because the service is actually a promise that the salesperson in the service industry is selling (Beckwith, 2005).

In addition to the above, a successful salesperson has to develop a number of other competencies from different field of work and behaviour.

A successful salesperson must have a precise plan of his activities. In their work successful salespersons use an activity plan that enables efficient sale of different products in different circumstances (Becker, 2006). But the sales plan alone is not enough to make the most successful salespersons as top results also require a winning orientation and mastery of the top-level sales strategies. According to Schwable (1993), a good salesperson must think positively, be enthusiastic, and love his job. A salesperson must know that passive behaviour does not yield results. Creativity, ingeniousness, and having experience are the characteristics that a good salesperson needs. One of the most important principles discovered in the field of human employment is a winning orientation. This concept suggests that small differences in skills can be reflected in big differences in results. If a person improves a little at crucial jobs, this can significantly affect sales results. The quality of thinking determines the quality of life and positive thinking is in strong connection with the sales efficiency in every field (Tracy, 1997).

According to that, the salespersons' competencies can be divided into three areas: technical (use of knowledge of procedures, techniques, methods, tools), conceptual (critical and analytical thinking, creativity, deductive thinking, understanding of the causes and consequences) and interpersonal (understanding other people feelings and influencing their behaviour with appropriate communication, motivation and leadership competencies) (Sypniewska, 2013). To succeed in sales it is also of great importance the salespersons' appearance. Customers are often susceptible to the messages that salespersons send with their appearance and behaviour. The first appearance affects all the following actions (Bednarczuk, 1990). A customer gets an impression in the first four seconds. In the moment when a customer comes in contact with the salesperson the latter leaves an indelible impression. From this moment on the customer is searching for information and proof to confirm his impression. 95% of the first impression is created by clothing as clothing covers 95% of the body. Every salesperson has to be aware that the apparel can harm or help in sales and that the customers prefer shopping with salespersons

that look like them (Bansch, 2013). Because of this they should on the base of self-monitoring carefully create and maintain desired impressions (Gardner and Martinko, 1988; Turnley and Bolino, 2001), including external and internal neatness.

3 Survey Methodology

Based on previous internal surveys Relax Turizem came to the conclusion that several factors influence the efficiency of sales, including the place of purchase and salespersons who are in direct contact with the customers. Salesperson's efficiency does not depend only on the quality of fulfilling basic tasks (i.e. following a common achievement plan, following communication with the potential buyers and those who already spent their holidays, archiving of and familiarity with the messages, updating and use of tools for efficient sale, preparation for daily sale) (Asiegbu and Powei, 2012; Stewart, 2003) and mastering the skills for efficient sales, but also depends on the external and internal neatness of the place of purchase, including the internal and external neatness of the salesperson.

That encouraged us to explore the relationship between the factors that may have influenced the sales efficiency at the place of purchase**.** The subjects of the survey were the neatness of the place of purchase and neatness of the salespersons, while considering the assumption that the neatness of the place of purchase and that of the salesperson correlate to the efficiency of sales. The gathered survey results would be the basis for forming the training programme for salespersons at the place of purchase.

Survey objective and survey questions

As mentioned before the subject of this survey was sales efficiency of Relax's places of purchase and salespersons. Considering the assumption that the efficiency of the place of purchase is influenced by different elements, the survey objective was to establish the impact level of individual aspects of neatness of the place of purchase on the efficiency of the place of purchase and its salespersons and to answer the survey questions:

- RQ1: Which elements of the neatness of the place of purchase affect the efficiency of salespersons and business units in the Relax Turizem company?

- RQ2: Which elements of internal and external neatness of the salesperson affect their sales efficiency?
- RQ3: Is there a connection between the assessment of the chosen factors of the salesperson's efficiency and average realised turnover of the salesperson in a workday?
- RQ4: What is the salesperson's' opinion about the impact of individual competencies on their performance?

The survey included 23 Slovenian business units and their full-time employed salespersons at the place of purchase. In the time of survey there were 30 of them (100% sample).

Survey framework

The survey was conducted in three sequential steps.

The first step: For the purpose of the survey two survey instruments were designed: the first one for assessing the neatness of the place of purchase and the second one for assessing the neatness of the salesperson.

The second step: Observation and assessment of the neatness of the place of purchase and salespersons was conducted. The assessment was conducted by three regional directors qualified for assessment and evaluation of work processes according to ISO standards. This step also included examination of salespersons' perception of assessed competencies.

The third step: The assessment results were the basis for further calculation of the correlations. The gathered results were processes by SPSS Statistics.

To determine the impact level of single elements on the salespersons' efficiency the chi square and contingency coefficient were calculated, and to determine the impact level of external and internal neatness of the place of purchase on the efficiency of the business unit the Spearman's coefficient was calculated. In addition, the descriptive statistics were computed on the salespersons' attitudes toward assessed competencies.

Designing the survey instruments

Instrument for assessing the neatness of the place. Usually we first influence the potential buyer in his environment, i.e. outside of business unit, by a direct

communication through catalogues or indirect communication through media, sometimes also by references (Fill, 2009). Only when the potential buyer approaches the place of purchase we can influence him by existing facts such as the neatness of the place of purchase, neatness of the salesperson etc. (Becker, 2006).

According to that we can understand the external neatness of the place of purchase from the aspect of a good impression about the organisation that includes cleanliness, orderliness, and matching of the external marking of the place of purchase, and from the aspect of wholesome influence on the purchase decision that includes an advertisement board, a catalogue stand, and showcase surfaces.

The internal neatness of the place of purchase can be understood from two aspects. The first aspect presents internal neatness from the aspect of a customer's well-being that includes: cleanliness (clean floor, shelves, and furniture, pleasant scent), orderliness (tidy room), harmony in the sense of warmth, friendliness, and trust. The second aspect presents the wholesome influence on the purchase decision that includes all the elements in the room (video presentation of the hotels on offer, catalogues, stands, children's corner), on the walls (maps, posters of logistics graphic presentations, certificates), on the counter or in the immediate vicinity (in general should be empty, with only computer screens on it), on the table surrounded by chairs (photographs, folders with interesting offers, current special offers).

According to aforementioned, the assessment list for neatness of the place of purchase included 19 aspects of external and internal neatness:

- name board must be visible,
- external display is to be changed at least three times a week,
- in the front window captions are attractive and visible from far away,
- in the front window there are at least two competitive advantages published on an attractive way every week,
- in the front window all the Relax's offers are consistently updated,
- neatness of the customer area,
- in front of the business unit there is a board with special offer,
- inside the business unit there are at least six Relax advantages visibly and ingeniously presented,
- Relax's offers are presented in a creative way on the counter,

- there are no out of date offers (e.g. catalogues) in the area,
- business unit is decorated in accordance with the season (e. g. winter, summer, Easter and Christmas holidays),
- there is a children's corner,
- required certificates are posted on the wall,
- there is a nice scent in the business unit,
- there are maps hanging on the wall,
- video presentation of the hotels on offer is in a visible place,
- the health insurance offer is in a visible place,
- the business unit has the book of comments in the suitable place,
- toilets are clean and tidy.

The above listed aspects of external and internal neatness were rated from 1 (aspect is entirely absent) to 5 (the aspect is fully present).

Instrument for assessing internal and external neatness of the salespersons. The assessment list of the neatness of the salesperson included 11 factors, i.e. competencies. Factors and their descriptions were selected on the basis of the literature (Stewart, 2003; Sujan, Sujan, and Weitz, 1988), previous researches and consultations with the persons in Relax Turizm company key positions. They were also discussed in the focus group consisted of the most successful salespersons.

The following factors could be rated from 0 to 5:

- *External neatness of the salesperson – first impression.* Efficiency of this factor was measured by wearing a uniform, badge, and other elements of external neatness. The rates ranged on a scale from 0 to 5, where 0 meant that the salesperson is not wearing the uniform or the badge, while 5 meant that he is in a uniform, wearing the badge, with a tidy hairdo, face, and nails, and smells nicely.
- *Salesperson's non-verbal communication at the time of entry of the buyer – first impression.* This factor of efficiency was measured according to the salesperson's gesticulation and facial expressions in a given moment. The rates ranged from 0 to 5, where 0 meant that the salesperson did not even register the buyer when the latter entered the room, while 5 meant that the salesperson enthusiastically welcomed the buyer and that his non-verbal communication was impeccable.

- *Salesperson's verbal communication at the time of entry of the buyer – first impression.* This factor measured the appropriateness of the salesperson's first verbal communication when the buyer entered the place of purchase. The rates ranged from 0 to 5, where 0 meant that the salesperson did not register (did not great them) the buyer when they entered the room, while 5 meant that the salesperson kindly addressed the buyer when they entered and expressed their enthusiasm.
- *General geographical knowledge.* This factor was measured on the basis of salesperson's knowledge of countries, cities, and continents from Relax catalogues, including familiarity with the climate and economic conditions. The rates ranged from 0 to 5, while 0 meant that the salesperson cannot point out the countries, cities, or towns that appear in Relax catalogues, while 5 meant that the salesperson can show all the continents, countries, and towns and can explain different climates.
- *Familiarity with Relax tourist products from the aspect of content, logistics, payment conditions, and other accompanying information.* This factor was measured on the basis of a written test on Relax products. Assessment was determined according to the mark on the test, expressed in % and by points on a scale from 0 to 5, where 0 meant that the salesperson did not even pass the test on familiarity with Relax products, while 5 meant that the salesperson achieved the maximum number of points (100%).
- *Following the competition.* The measurement was conducted on the basis of the number of competitive providers of tourist products on the Slovenian market that the salesperson was familiar with. The rates ranged from 0 to 5, where 0 meant that the salesperson is not familiar even with his neighbour's competitive offer, while 5 meant that the salesperson is familiar with the offers of more than five tourist agencies in Slovenia.
- *Positive thinking.* This factor was measured on the basis of salesperson's optimism, pessimism, and bad mood. The rates ranged from 0 to 5, where 0 meant that the salesperson is in a bad mood all the time and could not hide this from the customers, while 5 meant that the salesperson is a very positive person who also motivated their co-workers.

- *Self-initiative.* Self-initiative was measured on the assessment list by the number of newly acquired set groups. The rates ranged from 0 to 5, where 0 meant that the salesperson in the current year has not acquired a single set group, while 5 meant that the salesperson acquired at least 15 new set groups in the current year.
- *Friendliness.* The measurement of the type and level of friendliness was based on the subjective assessment of the assessors. The rates ranged from 0 to 5, where 0 meant that the salesperson was not even formally friendly to the customers, while 5 meant that the salesperson was genuinely friendly, smiling, and solved problems with a positive attitude.
- *Positive personality features.* The following features were observed: non-disputatiousness, does not hold grudges, keeps promises, diligence, consistency, frankness, honesty, communicativeness, continuous positive thinking, self-esteem etc. This factor was measured on the basis of the number of the salesperson's positive personality features. The rates ranged from 0 to 5, where 0 meant that the salesperson possesses less than 4 of the positive personality features, while 5 meant that the salesperson has at least 12 of the listed positive personality features.
- *Updating documents.* The measuring criteria were set according to the willingness of an individual to participate in organising common files. The rates ranged from 0 to 5, where 0 meant that the salesperson does not participate in organising the common files, while 5 meant that the salesperson self-initiatively and timely organises the common files – even for the others.

The assessment of the neatness of the place of purchase and salespersons was conducted in high season, from July to September 2013.

4 Survey Results

Based on the assessment results first the values of the correlation between the individual sales efficiency and elements from the list for assessing the neatness of the place were calculated.

This calculation was followed by the calculations of the correlations between individual salespersons' efficiency and their demonstration of competencies that have been included in Instrument for assessing internal and

external neatness of the salespersons. Due to the irregular distribution not following the Gauss curve and some extremes among the salespersons the survey on the influence of elements from the assessment list of the neatness of the salesperson on their individual efficiency was conducted on the basis of the calculated chi square and a contingency coefficient.

Salespersons' efficiency was measured by the average realised turnover in a workday. It was determined after the personal annual turnover plan of the full-time employed salesperson and was set to 850.000 Euros. According to those criteria salespersons were divided in three groups:

- Group I: unsuccessful salesperson: average turnover of 2.500 Euros per workday;
- Group II: partially successful salesperson: average turnover of 2.500–3.499 Euros per workday;
- Group III: successful salesperson: average turnover of 3.500 Euros and more per workday.

The calculated positive values of statistical variables are commented with the following correlations values: from the value 0.00 to including 0.20 there is no correlation or the correlation has no significant importance; from the value 0.20 to including 0.40 there is weak correlation; from the value 0.40 to including 0.70 there is moderate correlation; from the value 0.70 to including 1.00 there is a strong correlation.

The calculated values of correlations between the salespersons' efficiency and elements from the assessment list of neatness of the place of purchase showed correlation for every element.

The survey results showed strong correlation between three elements of neatness of the place of purchase and the salespersons' efficiency, namely: name boards are always lit at night (C = 0.97), the room with the sofa set is neat and tidy (C = 0.79) and inside the business unit there are at least six Relax advantages visibly and ingeniously presented (C = 0.71).

A weak correlation was calculated for three elements: there is a nice scent in the business unit (C = 0.39), Relax's offers are presented in a creative way on the counter (C = 0.39), and there are maps hanging on the wall (C = 0.39).

Positive but in terms of value insignificant correlation was calculated for the following elements: video presentation of the hotels on offer is in a visible place (C = 0.20), the health insurance offer is in a visible place (C = 0.17), and the business unit has the book of comments in the suitable place (C = 0.11) (Table 1).

Table 1 The results of the correlation between the elements of neatness of the business unit and the salespersons' individual efficiency

No.	INFLUENTIAL ELEMENT	CORRELATION (C)
1	name board must be visible	0,97
2	neatness of the customer area	0.79
3	inside the business unit there are at least six Relax advantages visibly and ingeniously presented	0.71
4	business unit is decorated in accordance with the season (e. g. winter, summer, Easter and Christmas holidays)	0.68
5	external display is changed at least three times a week	0.50
6	in the front window there are at least two competitive advantages published on an attractive way every week	0.61
7	there are no out of date offers (e.g. catalogues) in the area	0.61
8	there is a children's corner	0.56
9	toilets are clean and tidy	0.53
10	in the front window all the Relax's offers are consistently updated	0.50
11	in the front window captions are attractive and visible from far away	0.48
12	required certificates are posted on the wall	0.48
13	in front of the business unit there is a board with special offer	0.46
14	there is a nice scent in the business unit	0.39
15	Relax's offers are presented in a creative way on the counter	0.39
16	there are maps hanging on the wall	0.39
17	video presentation of the hotels on offer is in a visible place	0.20
18	the health insurance offer is in a visible place	0.17
19	the business unit has the book of comments in the suitable place	0.11

This calculation was followed by the calculations of the correlations between the neatness of the business unit and its efficiency.

The neatness of the business unit was measured with the first assessment list (Instrument for assessing the neatness of the place), while the efficiency of the business unit was measured with the average realised turnover in a workday, i.e. average realised turnover of all the salespersons in the business unit in a workday (Table 2). The calculated correlation value according to the

Spearman's coefficient was R = 0.71 which shows a strong connection between the neatness of the business unit and its efficiency.

Table 2 Efficiency of the business unit measured with the average realized turnover in a workday

Business unit (BU)	Average realised turnover in the business unit in a workday in Euros	Rang
BU 1	4.260	11
BU 2	2.040	2
BU 3	4.260	11
BU 4	10.269	16
BU 5	6.169	14
BU 6	4.228	10
BU 7	8.697	15
BU 8	4.690	13
BU 9	2.115	3
BU 10	4.153	8
BU 11	4.248	9
BU 12	3.110	7
BU 13	10.607	17
BU 14	1.756	1
BU 15	2.348	5
BU 16	2.304	4
BU 17	2.459	6

The second part of survey consisted of calculation the correlations between individual efficiency of salespersons and observed competencies from Instrument for assessing internal and external neatness of the salespersons.-The results on the influence of salespersons' neatness on their efficiency were obtained with the Spearman's rank correlation coefficient.

The calculated correlations show the strongest connection between the individual efficiency of the salesperson and their verbal communication at the time of entry of the buyer (C = 0.82). This is followed by nine moderate connections, namely: following the competition (C = 0.65), non-verbal communication at the time of entry of the buyer (C = 0.59), documents updates (C = 0.59), external neatness of the salesperson (C =0.56), positive personality features (C = 0.55), positive thinking (C = 0.50), friendliness (C = 0.50), useful self-initiative (C = 0.47), and general geographical knowledge (C = 0.41). The connection between the familiarity with Relax tourist products and salespersons' sales efficiency was weak (C = 0.38) (Table 3).

Table 3 The results of the influence of the salesperson's internal and external neatness on his individual efficiency

No.	INFLUENTIAL ELEMENT	CORRELATION (C)
1	external neatness of the salesperson	0.56
2	non-verbal communication at the time of entry of the buyer	0.59
3	verbal communication at the time of entry of the buyer	0.82
4	general geographical knowledge	0.41
5	familiarity with Relax tourist products	0.38
6	following the competition	0.65
7	positive thinking	0.50
8	useful self-initiative	0.47
9	friendliness	0.50
10	positive personality features	0.55
11	updating documents	0.59

The results of the influence of salespersons' neatness on his efficiency were obtained by the Spearman's rank correlation coefficient The calculated connection of individual's efficiency and the assessment of his internal and external neatness was moderate (C = 0.42).

The study also explored the perceptions of salespersons about personal internal and external neatness. The following Table 4 demonstrates the tabulated results of the perceptual assessment.

For the purposes of this study, the strength of agreement indicated by each level of response was categorized as low if less than 2.25, moderate if between 2.26 and 3.75, and high if more than 3.76. These designations were selected arbitrarily for purposes of comparison only.

Respondents agreed that external neatness of the salesperson (M = 3.90), verbal communication at the time of entry of the buyer (M = 3.94), non-verbal communication at the time of entry of the buyer (M = 3.85) and familiarity with Relax tourist products (M = 3.80) are highly important for successful sale. Useful self-initiative (M = 3.66), general geographical knowledge (M = 3.62), updating documents (M = 3.52), friendliness (M = 3.46), positive personality features (M = 3.42) and positive thinking (M = 3.41) have according to respondents opinion moderate impact on sales efficiency. Most respondents were convinced that following the competitors does not have essential impact on their sale effectiveness (M = 1.92).

Table 4 Aggregate responses of salespersons concerning their main competencies

Salesperson' Competencies	N	Mean	Most frequent value	Std. Deviation	Min	Max	Rang
external neatness of the salesperson	30	3.90	4	1.04	1	5	2
non-verbal communication at the time of entry of the buyer	30	3.85	4	.65	1	5	1
verbal communication at the time of entry of the buyer	30	3.94	4	.74	2	5	3
general geographical knowledge	30	3.62	4	.90	1	5	6
familiarity with Relax tourist products	30	3.80	4	1.29	1	5	4
following the competition	30	1.92	2	.98	1	5	11
positive thinking	30	3.41	3	.89	1	5	9
useful self-initiative	30	3.66	4	.56	1	5	5
friendliness	30	3.46	3	.62	1	5	7
positive personality features	30	3.42	3	.73	1	5	8
updating documents	30	3.52	4	.88	1	5	10

Legend: 1 – Unimportant; 2 – Of Little Importance, 3 – Moderately Important; 4 – Important; 5 – Very Important

5 Results and Discussion

The study, executed in 2012, offers the insight into the impact of the place of purchase appearance and the competencies, referring to the neatness of the employees on the sales efficiency.

The study was designed to determine the correlations between the sales efficiency of individual salespersons and the sales efficiency of the business unit on one hand and the elements of internal and external factors of neatness on the other hand. The elements of internal and external factors of neatness were specified separately for salespersons and for the place of purchase, e.i. business units.

Calculated correlations between each individual element from the assessment list of the neatness of the place of purchase and the average realised

turnover of a salesperson in a workday were different in strength, but they were all positive. The importance of the internal neatness of the place of purchase is shown by strong correlation regarding two elements that refer to the neatness of the customer area (C = 0.79) where a buyer can browse through the catalogues and other offers in peace and learn about Relax's competitive advantages (C = 0.71). The influence of the external appearance of the place of purchase was also confirmed. The correlation coefficient between individual sales efficiency and of external recognition of the business units was the strongest correlation in the survey (C = 0.97).

The gathered results indicated that physical appearance matters and they suggest that Relax Turizem should focus on the external presentation of the place of purchase to ensure there are satisfied buyers inside. Namely buyers form their opinion on the quality of business on the basis of physical appearance, which heavily influences their decision to shop at a location. The external and internal appearance including cleanliness and organization is as important in their selection of a place to shop as customer service, variety of supply and cost. Buyers form impressions about the quality of offer on what they see outside and inside the place of the place of purchase (Blijlevens, Creusen and Schoormans, 2009).

The survey confirmed also initial presumptions that the extent and quality of the sales are bigger due to better internal and external neatness of the salespersons. Calculated correlations between the average realised turnover of a salesperson in a workday and each individual element from the assessment list of the neatness of the salespersons were different in strength, but they were all positive. The strong influence of the elements of neatness of the salespersons on individual efficiency shows the importance of verbal communication at the time of entry of the buyer (C = 0.82), which is followed by salespersons' non-verbal communication (C = 0.59) and their external neatness (C = 0.56). All of them highlight the power of impression management ie. the process whereby people seek to control the image others have of them (Proost, Germeys, and Schreurs, 2011).

The quality of salespersons' work is also influenced by their knowledge, monitoring competitive providers of tourist services, positive personality features, friendliness, and administrative work, e.g. updating documents. These findings are consistent with the findings of previous research on

salespersons' competences. Thus, Asiegbu and Powei (2012) stress that the salespersons' competencies consist of skills, knowledge, self-concept, and motives that encourage result orientation, adaptability, initiative taking, competing against a standard of excellence etc.

In the last part of the study we investigated salespersons' attitudes towards factors related to their performance. The examination of the means obtained for the variables concerning salespersons' opinion about the impact of individual neatness on their performance indicate that they have positive attitudes towards all of them. Verbal (M = 3.94) and non-verbal communication (M = 3.90) supplemented by appearance (M = 3.90) are the most influenced factors. The knowledge about Relax tourist offer (M = 3.80) and overall knowledge have also positive influence on their sale success (M = 3.62). These results indicate that only minor deviations from the salespersons' opinion and the results of correlations between their performance and the assessment of their neatness exist. This is encouraging as it shows that salespersons are aware of the importance of factors that are important to their success.

6 Conclusion

Due to increasingly aggressive development of information technology, increased competition in the market and obsolete thinking patterns of the salespersons the classic sale at the place of purchase is in great danger. Only modernised forms of sale at the place of purchase, complemented with the controlling of as many as possible influential elements can have a future in the sale of the tourist products.

Based on the gathered results of the whole survey it was established that in Relax Turizem the need for more detailed training of salespersons has arisen. The training would be mandatory for all the salespersons, regardless of their sales efficiency. It would be reasonable to include all the influential elements from both assessment lists in the training since all showed positive correlation, even though for some it was less significant. For the training to be more widely applicable it would be reasonable for it to also include other elements that directly or indirectly affect the sales efficiency, such as the external and internal neatness of the salesperson which is, together with the neatness of the

place of purchase, certainly one of the fundamental conditions for efficient sales in the place of purchase.

To establish a comprehensive and effective system for increasing sales efficiency at the place of purchase it would be necessary to repeat the survey after the realisation of the training of salespersons. Possible established increased efficiency would confirm that it is prudent to continue the permanent training of salespersons and to further develop the company's sales network where the sale at the place of purchase is carried out.

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Impact of Theory of Consumption Values Motives on Intention to Use Deal Sites

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Abstract. Deal sites became a widely used over the period of last several years. But there is still only a limited number of papers investigating their adoption and use from a customer perspective. Most of the research published on the topic is rather exploratory than using existing theories. The Theory of Consumption Values is a marketing theory that explains purchase behavior. The aim of this paper is to test if the Theory of Consumption Values motives influence intention to use deal sites.

Keywords: deal sites, theory of consumption values, empirical research.

JEL Classification: L86, M31, C12

1 Introduction

Deal sites can be used by companies selling goods or services. They are web portals that offer a certain product for a discounted price for a limited period of time, sometimes a day; therefore, they are also often called daily deal sites or deal of the day sites. Deal sites could classified in the framework according to Taran et al. (2016) as "round-up buyers", "affinity club", and "trade show". Probably the first popular deal site was Woot; it was launched in 2004, and it was acquired by Amazon in 2010. Since then, many deal sites emerged. From the better known deal sites, LivingSocial was launched in 2007, and Groupon was launched in 2008.

These days, probably most people think of Groupon when talking about deal sites. There are several reasons for it. First of all, the company spends a high percentage of the budget on marketing activities, i.e. it is visible. Secondly, it was discussed in mass media because of several reasons. It was the first deal site to go public - in late 2011. Moreover, it was the biggest initial public offering by an Internet firm since 2004 when Google went public. Media coverage in financial media was even higher due to the fact that Groupon did not use standard accounting metric but it tried to present revenue as profit while, actually, the company was in loss. Additional media coverage stems

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from the fact that the stock price was falling already shortly after it started to be traded - from $20 it went to almost $30 but it fell approximately one tenth since then.

The core feature of deal sites is that they offer coupons (discount vouchers). These (deal sites) coupons need to be purchased (old-time paper coupons were typically for free in newspapers or alike). Deal sites coupons usually offer deep discounts (possibly of 50% or more). Groupon's business model is specific in a sense that these coupons become valid (and money is withdrawn from customer credit cards) only if there is a threshold number of coupons sold for a particular service or goods within a certain amount of time. Customers tend to share the offers they like/purchased/want to become valid on social media in order to attract more customers, so the threshold number of sold coupons is achieved. This specific feature of Groupon generates additional social media buzz compared to deal sites that do not require a threshold number of coupons to be sold in order for a coupon to become valid.

Last but not least reason for deal sites to be discussed in media is the fact that both customers and companies have mixed experience with using deal sites coupons. Edelman, Jaffe and Kominers (2016) analyzed how to make offers profitable for companies selling Groupon coupons and they suggested that it would make sense for a company to allow a customer to buy only one coupon. But Friedman and Resnick (2001) pose that such a restriction is hard to implement because a consumer can set up more than one account and buy more coupons from one company this way.

The Theory of Consumption Values (Sheth, Newman and Gross, 1990) provides a framework to categorize customer's motives for buying:

- functional values - values related to utility,
- social values - values related to being highly valued by others,
- epistemic values - values related to learning,
- hedonic values - values related to pleasure,
- conditional values - functional and/or social values present only in some situation.

The Theory of Consumption Values is not so widely used - there are only 18 entries at the Web of Science Core Collection - 14 journal articles and 4 conference papers - besides the article published by Sheth, Newman and Gross

(1991) which was already 396 times cited by Web of Science Core Collection, many times instead of their book (Sheth, Newman and Gross, 1990).

The aim of the paper is to investigate if the Theory of Consumption Values influence intention to use deal sites and if so, which of these motives influence intention to use deal sites. The rest of the paper is organized in the following way: In the next section, there is a description what data were collected and how, and how they were analyzed. In the following section, results of the analysis are presented. The last section offers conclusions.

2 Data and methodology

Data were collected in the spring semester 2014 using an on-line questionnaire. Respondents were 284 university students from Denmark, of which 153 were male and 131 female. Most of them were from Aalborg and Aarhus universities in their first to fourth year of study. Of them 131 stated that they used deal sites and 96 of them fully filled the questionnaire, so the effective sample size is 96.

With regards to measuring motives and intention to use deal sites, responds were asked "To what extent do you agree with the following statements?" on a 1-7 Likert scale were 1 meant strongly disagree and 7 meant strongly agree. The order of all these statements was randomized in order to minimize the effect of one answer influencing the following answer.

Statements for the functional motive were adapted from (Venkatesh, Thong and Xu, 2012):

- I find deal sites useful in my daily life
- Using deal sites increases my chances of achieving things that I need
- Using deal sites allows me to find deals more efficiently in comparison with other media
- Using deal sites helps me to find deals more quickly in comparison with other media

Statements for the social motive were adapted from (Sweeney and Soutar, 2001) and an additional one from (Yeh and Teng, 2012) who adapted it from (Au, Ngai and Cheng, 2008):

- Using the deal sites helps me to feel accepted by others
- Using deal sites makes a good impression on other people

- Using deal sites gives me social approval
- Using deal sites would improve the way I am perceived
- Using deal sites enables me to get more recognition from friends and family when I tell them

Statements for the epistemic motive were inspired by multiple scales:

- I used deal sites to experiment new ways of doing things
- I used deal sites to find the new offers
- I used deal sites out of curiosity
- I used deal sites to learn about new types of products, services
- I used deal sites to learn about locations of stores/restaurants

Statements for the hedonic motive were adapted from (Venkatesh, Thong and Xu, 2012):

- Using deal sites is fun
- Using deal sites is enjoyable
- Using deal sites is entertaining

Statements for conditional values were invented:

- I value the information this service offers with the help with which I get what I need once in a lifetime events (e.g. purchasing a wedding gown)
- I value the information this service offers with the help with which I get what I need in emergency situations

Statements for the intention to use were adapted from (Venkatesh, Morris, Davis and Davis, 2003):

- I intend to use deal sites in the next 3 months
- I expect that I would use deal sites in the next 3 months
- I plan to use deal sites in the next 3 months

Average values were used for each construct. The five Theory of Consumption Values constructs were validated by Sudzina (2016). Cronbach's alpha for the six constructs ranged between .707 and .912, i.e. higher than Nunnally's (1978) threshold of .7. Multiple linear regression was used to analyze impact of five Theory of Consumption Values motives on intention to use deal sites. SPSS software was used for the analysis.

3 Results

The research question is if/what Theory of Consumption Values motives influence intention to use deal sites. Multiple linear regression results for the full model are provided in Table 1. The model per se is significant, p-value < .001, R^2 is .524, R^2_{adj} is .498.

Table 1 Multiple linear regression for the full model

	B	S.E.	Beta	t	Sig.
Constant	.075	.480		.156	.876
Functional	.844	.142	.624	5.957	.000
Social	-.148	.129	-.098	-1.150	.253
Epistemic	-.011	.159	-.007	-.068	.946
Hedonic	.286	.114	.230	2.499	.014
Conditional	-.023	.132	-.015	-.172	.864

The most significant independent variables influencing intention to use deal sites are functional and hedonic motives. If gender was included in the model, its p-value would be .818. Carlson and Wu (2012) suggest to exclude independent variables that are not significant. Multiple linear regression results for the streamlined model are provided in Table 2.

Table 2 Multiple linear regression for the streamlines model

	B	S.E.	Beta	T	Sig.
Constant	-.146	.407		-.358	.721
Functional	.785	.114	.581	6.858	.000
Hedonic	.268	.105	.216	2.552	.012

The model per se is significant, p-value < .001, R^2 marginally dropped to .515 and R^2_{adj} marginally increased to .505. The regression coefficient for the functional motive marginally decreased and the regression coefficient for the hedonic motive stayed the same.

To sum up, from five motives proposed by the Theory of Consumption Values, only two - functional and hedonic motives - influence intention to use deal sites. Both have a positive influence, and influence of the functional motive is about 3 times higher than of the hedonic motive.

4 Conclusion

Although there is an increasing body of knowledge about deal sites, there are virtually no studies that use existing marketing or information systems theories to investigate what drives use of deal sites. The aim of the paper was to investigate impact of the Theory of Consumption Values motives on intention to use deal sites.

With regards to the results of the analysis, it is functional and hedonic values that influence intention to use deal sites, both in a positive way. Impact of the functional motive is stronger, though both are significant. It is interesting that gender does not influence intention to use deal sites because many technology adoption studies show that gender matters.

The Theory of Consumption Values, namely functional and hedonic values, explain about half of the variance. Future research should aim to identify what motives explain the second half of variance. This will require testing of other theories and it will probably require also qualitative research.

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Maturity Models in IT Service Management: An Overview

Agnieszka Zając

Abstract. Disciplines of information technology (IT) and information systems (IS) have evolved into various sub-disciplines and extended over many areas of applications. Such topics like Business Process Modeling (BPM), IT Governance, Business Intelligence (BI), Project Management (PM) or Information Technology Service Management (ITSM) are strictly connected with IT/IS domain. Many of these approaches utilize the concept of maturity models when describing the advancement of a given solution and/or technology. The goal of the paper is to identify the most known maturity models used in IT/IS field and their specification. As a result, the relevance of selected maturity models to the ITSM will be provided together with the possibility of application in different service oriented areas.

Keywords: Maturity model, IT Service Management, IT architecture, enterprise architecture.

JEL Classification: L86, M15

1 Introduction

Every organization that wants to survive and grow should be interested in examining its activities. Financial indicators could be not enough to determine the current condition of organizational activities. The concept of maturity gives possibilities to look at different areas of an organization and investigate its status.

Information Technology Service Management (ITSM) principles refer to best practices, standardization, quality and client satisfaction. It requires perfect processes and their integration as well as investigating the current condition of services and related procedures from the company that is utilizing ITSM approach.

The concept of maturity and maturity models is present within the management and IT/IS literature in the last few decades (Nolan, 1973; Nolan, 1979; King and Kraemer, 1984; Luftman, 2004; CMMI-SVC, 2009; P-CMM, 2009). Some models are more overall, some refer to specific areas of organizational activities. In the area of ITSM, the main approaches like Information Technology Infrastructure Library (ITIL), Control Objectives for

Information and related Technology (COBIT) and The Open Group Architecture Framework (TOGAF) include maturity measurement within their procedures (Van Bon, 2005; COBIT, 2007; Josey, 2011).

The goal of the paper is to explore possibilities and scope of maturity models implementation in the area of ITSM. The second part of the paper presents stages defined in the maturity models and an overview of the main characteristics. The third section is dedicated to examine the possibilities and extent of maturity model implementation in the area of ITSM. Conclusions concerning ITSM maturity measurement close the paper.

2 Concept of maturity and maturity models

Maturity of an organization can be seen as the ability to fully use potential of the organizational resources and capabilities. As there are many different areas of organizational activities, maturity may refer to specific functions or it may cover an entire organization.

The first attempts of maturity measurement were mentioned in, Nolan's model as it introduced in 70ies a way to manage computer resources (Nolan, 1973, King and Kraemer, 1984). Firstly, Nolan identified four stages of dealing with computers (Nolan, 1973, p. 401):

Stage I - Initiation (computer acquisition);
Stage II - Contagion (intense system development);
Stage III - Control (proliferation of controls);
Stage IV - Integration (user/service orientation).

After subsequent research, he added two more stages (Nolan, 1979):

Stage V - Data administration (control of computing resources is tight but slack and is maintained in the development of systems that bring high, added value)
Stage VI - Maturity (achieved when the applications portfolio is complete and its structure 'mirrors' the organization and the information flows in the company).

Nolan's model can be seen as the first maturity model, although it focuses on IT infrastructure and software.

Capability Maturity Model (CMM) was developed in the end of 80s and the beginning of 90s. It evolved into Capability Maturity Model Integration (CMMI) that currently covers three main areas of interest:

1) Product and service development - CMMI for Development (CMMI-DEV),
2) Service establishment, management - CMMI for Services (CMMI-SVC),
3) Product and service acquisition - CMMI for Acquisition (CMMI-ACQ).

According to CMMI there are five levels of maturity (CMMI-SVC, 2009):

1) Initial
2) Managed
3) Defined
4) Quantitatively Managed / Predictible
5) Optimizing

"CMMs focus on improving processes in an organization. They contain the essential elements of effective processes for one or more disciplines and describe an evolutionary improvement path from ad hoc, immature processes to disciplined, mature processes with improved quality and effectiveness." (CMMI-SVC, 2009, p. 5). Parallel to the development of service oriented models Software Engineering Institute (SEI) developed People Capability Maturity Model (P-CMM) focused on improvement of human resources in an organization. "From the perspective of the People CMM, an organization's maturity is derived from the workforce practices routinely performed inside it, and the extent to which these practices have been integrated into an institutionalized process for improving workforce capability. In a mature organization, responsible individuals perform repeatable workforce practices as ordinary and expected requirements of their positions. The more mature an organization, the greater its capability for attracting, developing, and retaining the talent it needs to execute its business" (P-CMM, 2009, p. 4). P-CMM incorporate CMMI stages but defines it from perspective of human resources development (P-CMM, 2009, p. 18):

1) Initial: Inconsistent management
2) Managed: People management
3) Defined: Competency management
4) Predictable: Capability management
5) Optimizing: Change management

Another framework developed on the basis of P-CMM and CMMI concerning process maturity is Business Process Maturity Model (BPMM). Similarly as CMMI it consist of five stages (BPMM, 2008, p. 4):

1) Initial - where business processes are performed in inconsistent sometimes ad hoc ways with results that are difficult to predict.
2) Managed - wherein management stabilizes the work within local work units to ensure that it can be performed in a repeatable way that satisfies the workgroup's primary commitments. However, work units performing similar tasks may use different procedures.
3) Standardized - wherein common, standard processes are synthesized from best practices identified in the work groups and tailoring guidelines are provided for supporting different business needs. Standard processes provide an economy of scale and a foundation for learning from common measures and experience.
4) Predictable - wherein the capabilities enabled by standard processes are exploited and provided back into the work units. Process performance is managed statistically throughout the workflow to understand and control variation so that process outcomes can be predicted from intermediate states.
5) Innovating - wherein both proactive and opportunistic improvement actions seek innovations that can close gaps between the organization's current capability and the capability required to achieve its business objectives.

Beside the already indicated models, Luftman's Strategy Alignment Maturity Model (SAMM) should be mentioned in the context of ITSM and IT - business alignment. SAMM proposes that IT - business alignment can be captured according to six areas of maturity (Khaiata and Zualkernan, 2009, p. 139):

- Communication maturity to ensure the ongoing knowledge sharing across the organization and the understanding of business by IT and vice versa;
- Competency / Value measurement maturity to demonstrate the value IT is contributing to the business;
- Governance maturity to ensure that the appropriate participants of business and IT are reviewing the priorities and allocation of IT resources;

- Partnership maturity to reflect the level of trust developed among participants of IT and business in sharing risk and rewards;
- Scope and architecture maturity to signify the level of flexibility and transparency the IT is providing to business; and
- Skills maturity to reflect the level of innovation, change readiness, hiring and retaining, and how they are contributing to the overall organizational effectiveness.

For each of these six areas, SAMM classifies the alignment between business and IT into five levels (Khaiata and Zualkernan, 2009, p. 139):

1) Initial / Ad hoc process, where business and IT are not harmonized or aligned;
2) Committed process, where the organization has committed to becoming aligned with IT;
3) Established / Focused process, where the alignment is established between IT and business and focused on business objectives;
4) Improved / Managed process, where the concept of IT as a "Value Center" is reinforced;
5) Optimized process, where the strategic planning of business and IT is integrated and reached a co-adaptive stage.

Maturity topic has been researched for last few decades and still may be seen as subject of development especially from the perspective of maturity measurement and methods of organizational improvement.

3 Maturity of IT Service Management

ITSM emphasis client perspective of IT services, business process oriented IT applications, standardization, quality and IT business alignment. It also focuses on a continuous service improvement seen not only as quality improvement and efficiency of the services, but as an improvement of all the areas and processes involved. The measurement of current ITSM processes and improvement of all the service related areas is nothing less than the awareness of maturity. It also introduces service oriented organization of IT units and strongly connects IT budgeting with bringing value to the client.

The main frameworks connected with ITSM that also stress maturity are COBIT, TOGAF and ITIL. All of the mentioned frameworks in the area

of maturity are based on CMM or CMMI concept[1]. For many years responsible organizations (i.e. independent associations) have developed a set of principles, processes, procedures, good practices and guidelines for the companies that want to change traditional IT departments organizations into service oriented. It should be mentioned that all these frameworks are still subject to improvement.

From its definition the goal of every ITSM framework is "to ensure that the right processes, people and technology are in place so that the organization can meet its business goals" (TechTarget, 2016). It underlines such topics like processes, people, technology and strategy, that in the case of ITSM can be seen as the focus of IT-business alignment. As CMMI seems to cover most of ITSM basic areas, some deepest analysis of maturity would be useful to comprehend, plan, monitor and develop organizational capabilities. It will not be difficult to combine most of the described maturity models with ITSM areas. In the case of processes, BPMM may essentially help to determine the current maturity level as well as to improve processes in the future. Human factor of the services will be effectively supported by P-CMM. Technology related matters could be assisted by various areas of CMMI (CMMI for Development, CMMI for Services or CMMI for Acquisition) depending of the source and the scope of IT implementation and maintenance. In the area of technology also six stage Nolan model should be helpful. An integration of these three dimensions Luftman's SAMM can be applied also adding IT-business perspective and bringing together such aspects like communication, competency, governance, partnership, scope and architecture and skills maturity.

The main challenge of a successful ITSM development is to integrate all listed dimensions not only on the strategic level but also during their execution. The best practices that are build in ITSM frameworks can essentially help to monitor appropriate functioning of day-to-day activities but these capabilities can be largely supported by additional measures taken also from selected maturity models.

[1] TOGAF and latest version of COBIT relate to ISO/IEC 15504 standard, but ISO/IEC standard also bases on CMM model.

4 Conclusions

The concept of maturity in the area of IT is well developed in the literature and it is also covered by various models, approaches and standards. A special attention should be focused on CMM and CMMI framework as the concept has quite a long history and is still developing. Although CMM is already present in the most popular ITSM frameworks, it could be useful to bring some additional maturity model into service strategy, development, delivery and support. Most IT/IS ventures vastly depend on social aspects related to human resources but also clients and communication skills and capabilities.

Maturity models do not influence organizational capabilities by itself but they let diagnose current situation and give some guidance what should be improved and to what extent. The challenge is to answer the questions what to measure, how to measure and when it should take place. Awareness of the current maturity level is very important for the organization but the main attention should be placed on how to reach the next maturity level.

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