Proceedings of the IT for Practice 2013

16th International Conference on

Information Technology for Practice

IT for Practice 2013

October 10-11, 2013, Ostrava, Czech Republic

Edited by

Jan Ministr
Milena Tvrdíková

Organized by

Czech Society for Systems Integration - Moravian-Silesian Section
VŠB - Technical University of Ostrava, Faculty of Economics
European University Information Systems - CZ
in Collaboration with Karel Engliš Foundation

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Conference on Information Technology for Practice 2013

16th annual national conference with international participation

Welcome to the 16th IT for Practice conference held at Faculty of Economics VŠB-Technical University of Ostrava. This conference (currently with international participation) has become a traditional meeting of IT experts coming both from the practice and the academic spheres.

The conference is organized by Department of Applied Informatics of Faculty of Economics VŠB-TUO in cooperation with Czech Society for System Integration, and EUNIS-CZ, in collaboration with Karel Engliš Foundation.

The aim of organizers is to establish a platform for exchange of knowledge and opinion in IT innovation and their exploitation in the usage and development of information systems.

According to current problems in this field, this year of the conference is focused on the following topics:

- Competitiveness with IT support
- Process management and its IT support
- Information society and trends in IT education

Contributions regard these topics from different points of view. So we believe that at least some of contributions will be interesting for you and it will be a good inspiration for live discussion during the conference.

We wish you well-being in the solution of the problems in the turbulent world of IT and to establish new professional contacts useful for the solution of your specific problems.

On behalf of organizers,

Milena Tvrdíková, September 2013

C O N T E N T S

LIST OF AUTHORS

Competitiveness with IT Support

INFORMATION SYSTEMS IN ACQUIRING, STORING AND ANALYSING CUSTOMER INFORMATION

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ABSTRACT

The main objective of this paper is to describe information systems used in the acquisition, storage and analysis of information about customers. The selected definitions of CRM (Customer Relationship Management) are quoted in the article. A system of CRM type is characterised. Subsequently, there are singled out some functionality of selected systems of customer relationship management. The research results may be useful for improving the use of CRM systems.

KEYWORDS

Customer Relationship Management, customer data, Internet, business strategy, process

1 Introduction

The main objective of this paper is to describe information systems used in the acquisition, storage and analysis of information about customers. The article shows the multiplicity of CRM systems that can be used by businesses. The structure of the article is as follows. Firstly, based on the review of literature, the system of customer relationship management (CRM) is described. Further, the selected functionalities of miniCRM and Impuls Evo are presented. Finally, the key advantages and disadvantages of these systems are highlighted. The article provides valuable information on the opportunities offered to businesses by the use of information systems in improving customer knowledge. The results and impact of the research should be useful for all businesses that wish to use this type of systems.

2 Characteristics of CRM system

Recognising the needs of customers, predicting their behaviour and potential, developing a suitable offer in line with their expectations as well as creating a good relationship are becoming a major challenge for a modern organization. CRM systems, to a large extent, en-able the realization of those tasks, offering support to customers in their relations with an organization. Individual business processes, operational procedures have been reflected in the functionality of the various forms of CRM, their options, and data structures.

In view of the important role a customer plays in the enterprise, the information system of CRM type acts as an interface between an organization and its customers, contractors and co-operators. Therefore, the CRM system must give the enterprise the opportunity to get to know and to understand its customers. Analysing a wide range of CRM systems available on the market, it is difficult to identify one universal way to carry the above tasks out.

In practice, there are distinguished three different kinds of CRM systems such as (Shanmugasundaram, 2010; Wilde, 2011; Peppers & Rogers, 2011; Tuzhilin, 2012; Bartuś, 2010; Bartuś, Bartuś, 2012): operational, analytical and cooperative. It is worth mentioning that due to the rise in popularity of social media so-called Social CRM is growing rapidly, in other words customer relationship management in the social media (Olszak, Bartuś, 2013).

Operational CRM, also called the front office CRM (Buttle, 2009; Wilde, 2011), works in the collection of customer data (Minna and Aino, 2005). It supports business processes across marketing, sales and servicing, including the following (Olszak, Bartuś, 2013):

- marketing automation: market segmentation, campaign management and event-based marketing;
- sales force automation: opportunity management, contact management, creating an application, product configuration;
- service automation: contact and call centre operations, internet service.

Analytical CRM, called the back-office CRM, analyses customer data structure by allowing businesses to explore the unknown information about them (Minna and Aino, 2005). It enables enterprises to create advanced business analyses, forecasts (e.g. for market and consumer behaviour) and to generate operational reports (e.g. marketing research, sales). Those analyzes can provide the basis for further planning of future sales strategies, marketing campaigns, identifying customer needs and behaviour as well as estimating the cost of retaining existing and attracting new customers (Buttle, 2009; Wilde, 2011). Generally analytical CRM uses such advanced tools as: data warehousing, data mining (including: grouping and segmentation), marketing and campaign analysis. According to some authors Analytical CRM is recognized as an important element in the successful implementation of CRM in enterprises (Nykamp, 2001).

In turn, an important task of Cooperative CRM is to improve communication of an enterprise with its customers, business partners and suppliers. The aim is to build long-term cooperation. In order to communicate there are used the traditional channels of communication following means: voice applications, telephone, SMS, traditional mail and e-mail. Cooperative CRM is mainly used for direct communication with customers in the following departments (Kracklauer, Mills & Seifert, 2004; Wilde, 2011): maintenance service, sales and marketing.

Within the framework of CRM architecture some authors also indicate Strategic CRM (Aurelie & Laid, 2008; Payne & Frow, 2005). This is due to the organization's business strategy, which aims to strengthen relations with customers (Buttle, 2009). The relationships between listed above types of CRM systems are shown in the figure below.

It can be concluded that CRM systems can play a role of (Olszak, Bartuś, 2013):

- a central repository of customer information, common to all employees,
- a platform to communicate with clients, that is responsible for the transmission of various information, documents, content to customers,
- Internet portal which allows customer service,
- an analytical center, that, on the basis of customers' profiles, may offer products, services the most appropriate to their needs.

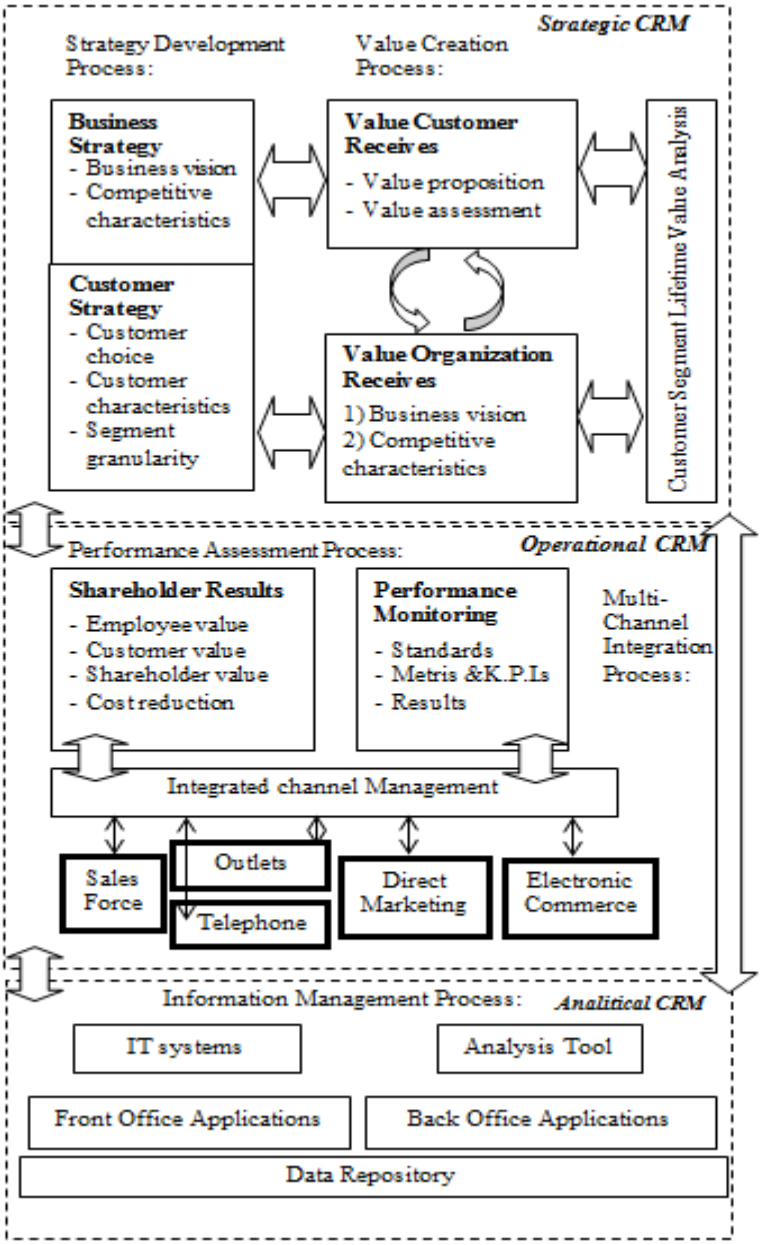

Figure 1. The relationships among CRM systems
Source: Olszak C.M., Bartuś T. (2013), Multi-agent framework for social customer relationship management systems, Proceedings on InSite 2013, Informing Science and IT Education, Portugal.

3 Characteristics of selected management systems of customer relationships

The market for IT solutions supporting customer relationship management is very wide. CRM systems are offered by such providers as:

- Microsoft 9crm.dynamics.com/pl-pl/home.),
- Oracle (www.oracle.com/us/products/applications/crmondemand/index.html.),
- SAP (www.sap.com/poland/solutions/business-suite/crm/index.epx.).

On the Polish market, one of the most important providers of this type of systems are: BPSC – Impuls Evo (www.bpsc.com.pl.), Teta – CRM (www.unit4teta.pl.), miniCRM (minicrm.pl.). These are systems where the availability of advanced functionality is very

wide. Usually the options are grouped into modules, from which the user can run a variety of forms to advance the selection processes related to customer service. The offer of local providers seems interesting, inasmuch as they can supply (or adjust) the functionality of a system at a level that is expected by a Polish local client (a potential user of CRM system). Also CRM systems provided on the principles of Open Source licensing are noteworthy. For example SugarCRM (www.sugarcrm.com.), vTiger (www.vtiger.com.) systems are still the most popular among this type of solutions available on the market.

3.1 Characteristics of miniCRM system

Minicrm.pl system (www.minicrm.pl.) has been created specifically to address the needs of small organizations that start an economic activity. It's important feature is that it is fully accessible via a web browser. This system supports only two processes related to sales, which are Tasks and Dealings. In addition to typical features associated with customers, which is the Contacts file that is used to efficiently manage business contacts, the system also has options for the planning of sales activities (1), Tasks file (Fig. 2), (2) Dealings file (Fig. 3) and (3) History of Operations module. As a result, it allows for monitoring activities of specific customers and the effective management of marketing campaigns. It is designed to work on many computer or mobile stations (there is required a device with Internet access, such as smartphone, tablet, netbook, notebook or desk-top PC), on which an Internet browser is installed.

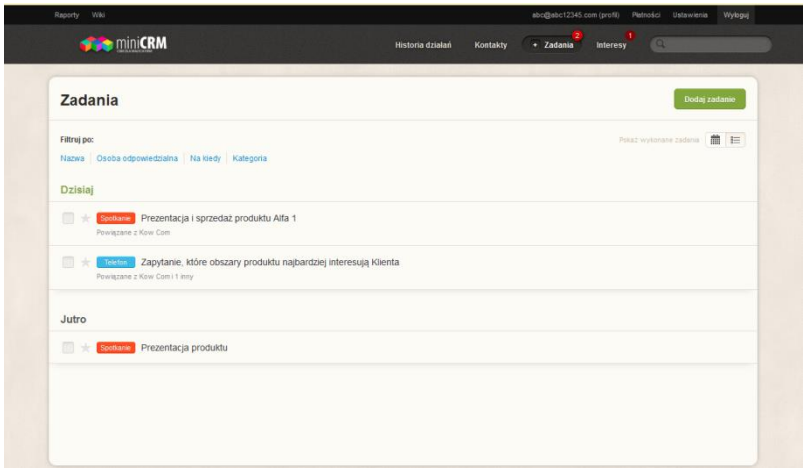

Figure 2. Sample screen displaying Task module

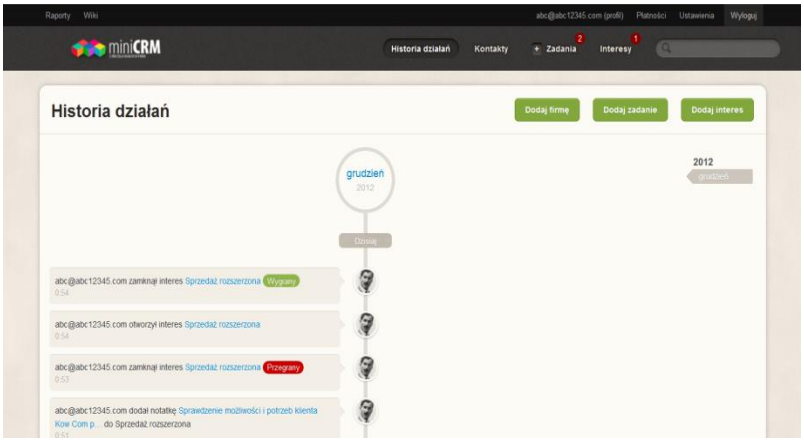

Figure 3. Sample screen displaying History of Operations module along with their implementation status

The main functionalities of the miniCRM system include:

- recording new: contacts of a company or a person type and assigning them appropriate keywords (tags),
- recording tasks (e.g. meetings, phone calls, e-mails) and dealings (attaining business objectives),
- history of operations, which allows for monitoring the status and duration of the action taken by individual users of s system by means of a so-called Timeline,
- managing system settings, including: user management systems, including logging into the system using a unique username and password, and registration of new users of the system,
- exports from and imports to a known text or Excel file (csv, xls) and online tools (e.g. Google apps),
- generating reports and Wiki (paid version only).

Among the advantages of the miniCRM system the following should be indicated:

- the possibility to work simultaneously with a number of users, and to work out of the office through the use of web architecture,
- the possibility of using a free version of this programme in organization's operations, which is functionally limited version of the full programme,
- the possibility to export data to a spreadsheet format, making it possible to use data more extensively (e.g. a mail merge can be prepared in a word processor on the basis of ex-ported data, a further data analysis).

The disadvantages of the miniCRM system are the following:

- significantly limited functionality (only three CRM functionalities: Contact, Task and Dealings),
- lack of modules connected with sales support, after-sales service and production,
- in the free version, a lack of possibility to perform analysis and reporting in a graphical form (possible in the paid version).

3.2 Characteristics of CRM module of Impuls Evo system

The CRM module designed by BPSC Company is an integrated package of ERP system, namely the system of Impuls Evo (www.bpsc.com.pl.). The CRM module, like the whole Impuls Evo system runs on Oracle database servers. According to the concept of CRM strategy, the most important element of CRM module is a database of customers. For each of them is formed so-called Customer Card, which is used to collect the most important information about his/her status (e.g. customer, prospect), contact details, size of turnover and contact persons. Through the CRM module the customer data archiving process begins before the customer's physical contact with the organization, since employees can enter data on a potential customer into the system, then he/she receives the status of a prospect. In addition to the template information recorded by the CRM functionalities, individual users of the system have the ability to define custom data item category. This applies in the case of customer service requiring a specific offer and service. The customer file in the process of formation is also used by the employees of the Sales Department. The CRM module through the integration with Impuls Evo can benefit from all the data stored in it (e.g. the

status of payments, the balance of the consumer's debt to the debt of all customers, the turnover volume with the customer's company and the profit margin and income reached thanks to this commercial relationship).

- so-called Top 1000, namely creating a ranking of 100/1000 customers, thanks to whom the organization derives the highest profits,
- identifying the group generating 80 percent of revenues yielded from the sales in a given period of time,
- identifying customers in the group, whose an identifier may be: a demographic or financial feature (e.g. turnover by a certain amount),
- automatically creating a customer list built on the basis of certain criteria.

Among many capabilities of the CRM module, a useful feature is the possibility to define reports from data stored in the system independently. The user autonomously constructs screen report based on the definition of the system and the headers. Next, the report can be printed or exported to a file (e.g. in xls format). In case the report is used periodically or cyclically, it may be stored in the system. Storing data on the customer is not only the very data supplemented by appropriate forms. In the system, there is a mechanism for saving attachments, which can be external files (e.g. data from marketing campaigns, reports, materials sent to customers) and the Internet addresses of customers.

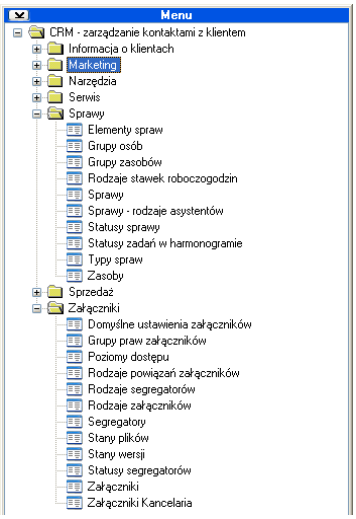

Figure 4. Sample screen showing the main menu of the system - CRM menu

The strengths of the CRM module of the Impuls Evo system include:

- possibility of mapping of all CRM processes in the Impuls system,
- the possibility to export data to a spreadsheet format, making it possible to use of data more extensively (e.g. a mail merge can be prepared in a word processor on the basis of exported data, a further data analysis),
- a built-in customer email, thanks to which without email data export to another programme, the organization may carry out mailing campaign.
- The disadvantages of the Impuls Evo system include the following:
- considerable complexity of the CRM module functions and of the system itself,
- necessity to have the installation of the system on a high-performance server,
- purchase of an expensive license.

4 Summary

Practice shows that the use of CRM system offers many advantages to organizations. They can both relate to organizations themselves as well as their customers. A synthetic scale of the benefits of CRM systems is shown in the figure below.

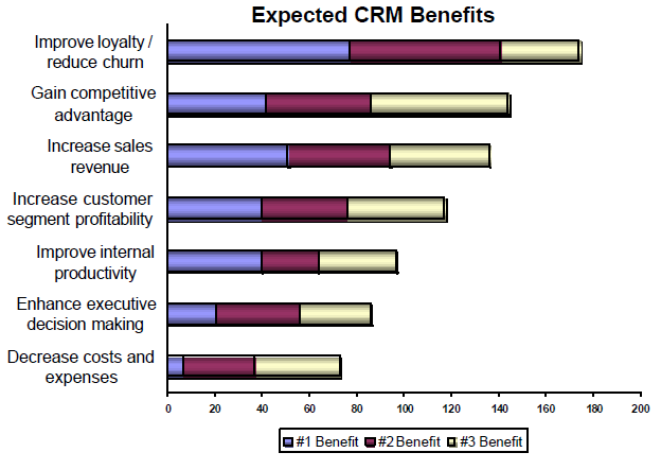

Figure 5. Expected benefits of the CRM implementation.
Source: Thompson B, 2013.

In conclusion, the use of information systems in an organization is forced by the shift from a product orientation towards a customer focus. Thus, the identification of customer needs, forecasting their behaviour, building offer in accordance with customer needs and creating a relationship between an organization and its customers are becoming a challenge for today's organizations.

The possibilities offered by modern CRM systems stay in line with the needs of organisations. They integrate a wide range of solutions that include leading marketing campaigns, meeting customer as an individual and a group of given characteristics and behaviour, the manner of utilizing the offer of an organization. In this way, an organization is able to determine the preferences and needs of potential customers which can directly encourage customers to purchase new products (e.g. through cross- and extended selling), to develop a new offer in line with customer needs, to improve the results of marketing campaigns.

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INFORMATION SYSTEM FOR SUPPORTING OF FORMATION AND EVALUATION COMPETENCES OF BANK STAFF

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ABSTRACT

In our paper firstly we will shortly describe four text mining approaches to sentiment analysis. In the next part of the work we will present stages of chosen methods of sentiment analysis. In this part we will touch such topics as texts characterization, tokenization, stemming and classification of opinions. Third part of the work is devoted to the research and its results concerning sentiment analysis of textual data collected from the Internet. We will sum up with some conclusions and further research plans.

KEYWORDS

Supporting Information System, cloud computing, bank, geographically distributed branches, staff, competences, formation, evaluation

1 Introduction

Changes in the external and internal environment of banks increased competition between banks, characterized by the expansion of the range of banking products and services through the introduction of modern information technology, complexity and improve the quality of banking operations, increase their volume requires the bank staff professionalism, continuous formation and development current core competencies in accordance with the requirements of profile of the position and of career planning.

Profile of professional competencies that meets the criteria set out requirements for regular office bank employee, contains not only the requirement to educational qualification but the experience and specialized knowledge, skills and abilities required to effectively perform their duties. Available in the prevailing bank employee competencies and assessment of their compliance profile of professional competencies established posts is a tool to use in different areas of personnel management, including the planning of staff, staff recruitment, training, training and evaluation, career planning and more. Profiles of competence is the basis for professional development, identifying personal training needs, improve training programs and approaches to the education system as a whole.

Education, training and retraining of employees of banks is based on a combination of formal, non-formal and informal forms of education according to the National Qualifications Framework []. In this case, the best results are obtained with the cooperation of banks specialized educational institutions, the leading of which in Ukraine is a University of Banking of the National Bank of Ukraine (UB NBU).

Example of such cooperation is the Educational-Industrial Complex "Zahidbankosvita" (EIC), which consists of universities and banks in Western Ukraine. University, like most banks, which are included in the EIC has a geographically distributed infrastructure. And the problem of building a system of on-line electronic support of development and evaluation of core competencies in students in the educational network of the University and in the Bank's employees in a corporate network staff development are the

same. The solution of these problems, in our opinion, is the wide use of modern information and communication technologies and electronic content.

2 Informational and educational technology in professional development of staff bank

Information and information technology used for its collection, high-speed transmission, processing and storage become a global factor that dramatically affects all human activities and continuing education in particular. Global network the Internet with its databases and knowledge, technology of "cloud computing", social servicies Web 2.0 and Web 3.0 gives users almost unlimited access to any information from a variety of sources, including special expertise, the results of original research, specific practical recommendations for action in different situations, and more.

Modern information technology also affects the collective modes of communication, thinking and action. Users have the opportunity to participate in the process of creating and using resources, creation of new services, the definition of resource development strategy as a whole, using computer networks and mobile networks. Prospects for network communications, the Internet and, in particular, corporate networks are associated with mobility. In 2012, the year of mobile users exceeded 1 billion, and in 2015, the projected increase of 2 times.

Thus there is avalanche, exponential growth of information, which can create the illusion to the user that in the World Wide Web you can find answers to any questions of theoretical or practical nature and should only properly orient. Therefore, in terms of information and communication revolution is the need that professionals are directed, oriented and evaluated of the use of bank employees increasing volume and opportunities for free access to information.

Solving tasks in a corporate system of bank staff development and in a educational activities of the geographically distributed University which is focused on entry into the global information and education environment and on innovation development, in our view, may contribute to the use of "cloud computing" technologies, which are increasingly used in education [1 -5].

They allow geographically separated structural units and individual users of various forms of learning to use modern and constantly updated corporate and global computer infrastructure, software, on-line electronic educational resources and services. For structural units this reduces cost on the local information infrastructure through: more efficient use of computing resources and electronic content are concentrated in the "cloud", reducing the cost of licensed software, reducing of the requirements for the qualification of IT departments and reducing the number of staff.

The "Cloud computing" also make it possible to do reengineering of management network structure of corporate services of development of bank staff, increasing the efficiency and adequacy of the decision-making process through access to real-time to a relevant information and tools for its storage, processing, continuous monitoring of deviations from targets, modeling and forecasting effects of corrective actions.

In turn, for the use of "cloud" technologies and social servicies needs rethinking concepts of training and development bank staff. They must be adequate to current capabilities of information and communication technologies which are becoming an integral part of the whole learning process, significantly boosting its performance. When you create and use information and pedagogical technologies in network support systems of all

electronic components lifelong learning (formal, non-formal and informal forms) needs to use competency's approach and to take into account the psychological and pedagogical features of perception and communication of today's youth which were are formed by the Internet and mobile communications. This trend are characterized by that youth needs to be constantly present in the Internet, of the reduction in communication volume text data, of shift to viewing photos, of reduction of time watching video content.

3 “Cloud” technology in the integrated system of personnel training and development bank

Members of the EIC Zahidbankosvita have been using some features "cloud" technologies based on the corporates data centers (CDC) and based on the corporate's networks and also they use integration of information and communication resources and interactive electronic content.

Usually there are the following basic classes of "cloud" services: IaaS (Infrastructure as a Service), PaaS (Platform as a Service), SaaS (Software as a Service). However, when trying to incorporate elements of "cloud" cognitive resources to the system of development bank staff may face problems related to the need to build a universal model of "cloud" resource containing actual knowledge that uniquely interpreted and oriented on technological use and on integration in external computer systems. It should draw attention to the proposed in [3] the concept of service Kaas -"Knowledge as a Service", "cloud" service, which is based on the distributed expert knowledge and has "actual knowledge that uniquely interpreted and provide decision support ", and provides technological tools for their use.

In this case, the standard architecture of corporate "cloud" contain reliable and survivable software and hardware core data centers, web server resource management of "cloud" and of access to its services based on http-protocol using web technologies, software of virtualization environment and managing virtual resources "cloud", as well as protocols and technology user access to a "cloud" services . The main classes of "cloud" services may be arranged in a hierarchy (stack) services «IaaS-PaaS-SaaS-KaaS», in which each higher level uses the resources of the lower level (Fig. 1).

Unlike IaaS and SaaS services, software of levels of SaaS and Kaas are much more diverse and a large number of independent producers creates them, respectively should be possible to create a special interface of "cloud" software (cloud-API), which will allow for the development of many SaaS-and KaaS-applications and their tolerance for different implementations of the "cloud". [4]

Department of Economic Cybernetics of the Lviv Institute of banking UB NBU focuses on the development and application of on-line electronic educational resources and services for the "cloud" services. Based on a systematic approach to the integration of new educational, informational and computer and communication technologies have been designed information and educational technology, based on the competency approach. Department developed a standard, management and presentation of educational content for the "cloud" services, and developed a electronic support and diagnostics of professional competencies in the system of continuous education in economics.

At development of teaching complex the Department is focuses on specific didactic principles of electronic teaching, namely modular informative, interactive collaboration, interactivity and practice-oriented technologies formation of professional competence.

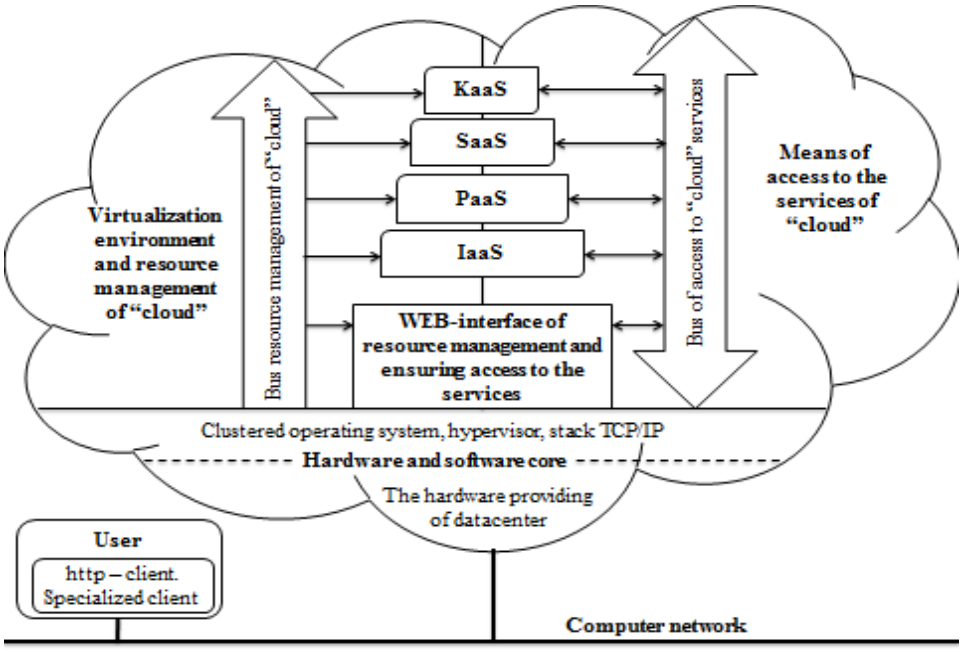

Fig. 1. The standard architecture of a corporate "cloud"

Particular attention is paid to the formation and development of the skills of reflection, self-examination, self-monitoring and self-evaluation and a procedures of self-evaluation are included in the evaluation of the level of competence.

Network system of electronic support of elements innovative educational technologies for formation professional competencies consists of interactive subsystems, including:

- Electronic multi-language Dictionary for support development and assessment of professional competence in conceptual and categorical fields of terms with using legislation of Ukraine, original methods of testing knowledge of the timing and the correct spelling of their names, methods of grouping of terms which related by the relevant content in regulations of the European Union (EU) or in one category of users (fig. 2).
- Training and e-reference subsystem support a legal (from the Ukraine and the EU) and professional competencies that are based on international and industry standards;
    - Situational and analytical subsystems forming of competencies modeling and decision-making with using modern intelligent information analysis technologies and fuzzy neural networks, software and hardware processing, display and data protection;
    - Subsystems of self-training and self-test using 6 types of tests on subjects and disciplines that supports the formation skills of reflection, self-awareness, self-control and self-esteem for the students and staff of banks;
- Educational and training subsystems development and evaluation of specialized professional цомпетенциис which based on ERP, BI and automated banking systems of a company SAP, PARUS, 1C, PROGNOZ, CS, CIS, UNITY-BARS, as well as laboratories CISCO and SearchInform Information Security Perimeter, which provide a students with practical skills;
- Subsystems of expert evaluation level of formation of a social and personal skills;
- Subsystems expert assessment of the quality of the teaching staff.

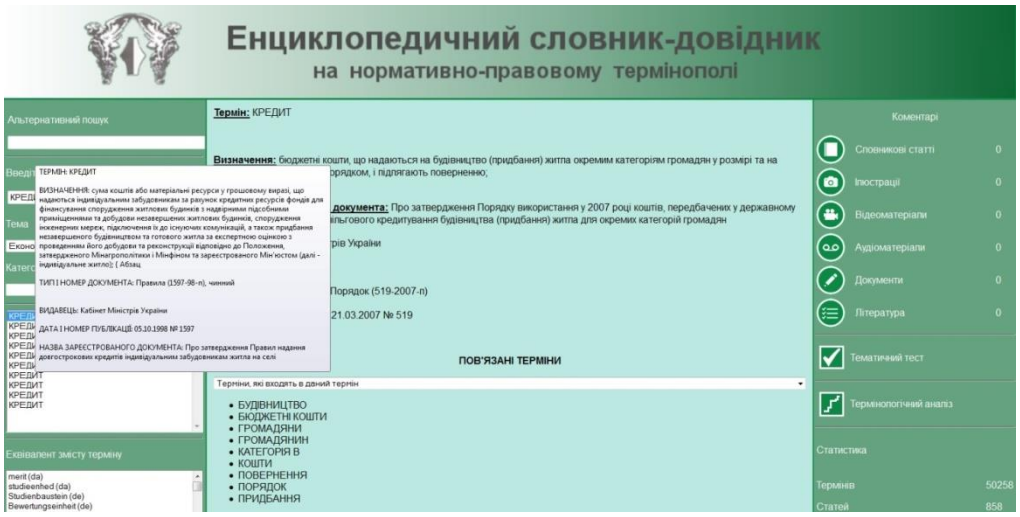

Fig. 2. Electronic multi-language Dictionary with using legislation of Ukraine and UE

All subsystems can accumulate over time data on the learning process and its results and make them intelligent processing system in order to build personalized dynamic model of students' competences, comparing it with the model of the qualification requirements of the post, which is prepared or which occupied by a customer and design on this basis individual plan for further learning opportunities using "cloud" technology distance learning.

4 Conclusions

The main practical advantage of the use of "cloud" technologies in e-Support of Staff Bank Development are: reduction requirements for technical equipment and training of users, optimizing the use of expensive high-performance hardware and software, simplify management process of license and their updates, standardization of operations within the quality management standards ISO 9001-2009.

Integration electronic educational resources UB NBU into corporate "cloud" services staff development bank of can significantly improve the quality and efficiency of electronic support development and evaluation of employees' professional competencies.

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IMPROVING COMPETITIVENESS OF POWER SECTOR BY APPLYING ARTIFICIAL INTELLIGENCE METHODS

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ABSTRACT
Article describes the theoretical validility and applicability of the artificial neural networks use in supporting management decisions. In empirical part of the article will be presented neural network based predictors on example of selected european energy exchange.

KEYWORDS:
Neural networks, power sector, time series, prediction

1 Introduction

Functioning of modern civilization depends on broad access to electricity. In the international environment, there are new phenomena that have a significant impact both on methods of forming an economic development strategy, as well as the operation of the respective companies. Accelerating globalization of markets, deregulation and liberalization of the trade process, decentralization of management sector structures leads to increased market competition, which is extremely important to the quality of services and product prices. Functioning and competitive position of the national economy is determined to a large extent by energy availability and price, which translates directly to national security and public order.

In light of these facts electricity sector should be considered as a sector of strategic importance. These conditions clearly indicate that managing power company needs tools such as forecasting for decision optimization. In such applications, various techniques of artificial intelligence including neural networks are increasingly being used.

The European Union is creating currently the world's largest competitive electricity market. On this market, energy exchange stocks are playing an increasingly important role. The share of the stock market in some countries reaches 75 % in the total volume of energy sold. With the stock market benefits not only manufacturers and distributors, as well as distribution companies and wholesale customers. With the more and wider participation of various actors electricity exchange sector is constantly developing and strengthening its position ensuring a market price level, competitiveness and security in the industry. The development of European energy exchanges has now reached the status of regional integration, which means to extend the exchanges administrative area on several countries. This trend is part of the currently in force, a European strategy for the development of the electricity sector, in order to create a single pan-European system. In the electricity sector it is therefore becoming increasingly important well-established methodology by which it is possible to precisely predict the price of energy.

2 Forecasting as a factor increasing the competitiveness of the energy company

After the process of forecasting and obtaining estimates of the projected variable raises the legitimate question of how the obtained forecast value use in practical applications. In today's socio-economic conditions making fast and accurate decisions primarily is necessary to maintain the company's competitiveness [Sobieska-Karpińska, Hernes, 2010]. Predicted

value then becomes the basis for reduction of risks related to undertaken decision. The forecasting results are used on the capital markets in order to maximize their income, and as the values allowing to manage investment risk [Piontek, 2003]. The situation is similar in the case of a competitive electricity market. The usability of an assessment result is determined in this case by the time range of prediction. Systematization of the forecasts in terms of the time horizon include:

- short-term forecasts (hourly or daily),
- medium-term forecasts (weekly or monthly),
- long-term forecasts (annual and several years).

Short-term forecasts are closely related to the spot market. Technical impossibility of storing electricity results in a very high degree of price volatility. As a result, the demand for the most accurate forecast of future price levels occur in both entities belonging to the supply side and the demand side [Bigdeli, Afshar 2009], [Conejo, Contreras et al. 2005], [Catalao, Pousinho et. al. 2011], [Serinaldi,2011]. On the supply side, they allow to plan the optimal level of energy production and to maximize the profit from the sale of energy [Alvarez-Ramirez, Escerela-Perez et. al. 2009]. On the demand side, they are instrumental in optimizing decisions on funding for the purchase of energy. Short-term forecasts can also be used by the operators of the electricity transmission system to detect speculative behavior, leading to volatility in energy prices[Li, Lawarree et al., 2010]. The importance of short-term forecasting is on the most competitive markets, a large share of the sector in the current electricity stock market turnover [Lorek, 2012]. A distinctive feature here is fundamental importance the most accurate prediction of the future price level. It is the difference in relation to markets with low levels of liberalization, on which the most important information is the future energy demand [Catalao, Mariano et. al. 2007]. On liberalized markets a large number of actors are present from the realm of both production and consumption. The electricity demand level and thus also the price of electricity may in this case be subject to dynamic changes. The accuracy of short-term forecasts in this case is a key factor in reducing the risk of overestimation or underestimation of future energy prices. This is reflected by the fact that the most valuable information for the entities belonging to the demand side is to foresee a dramatic increase in the electricity price as accurate as possible. Stakeholders from the supply side are most interested in predicting decreasing price changes [Mielczarski, Michalik-Mielczarska, 2001]. It should be noted, that the forecasting of prices on the liberalized market is a much more complex task of forecasting the demand for the regulated market [Angelus, 2001]. Because of this fact there have been attempts to make predictions using a variety of known methods of forecasting. Among the methods commonly used following can be distinguished [Aggarwal, Sini et. al., 2009]: game theory, simulation approach, statistical models, and models based on neural networks.

Medium-term forecasts results are used in the negotiation of bilateral contracts. They allow for more precise and profitable determining of the volume of contracted energy, and the price level [Conejo, Contreras et. al. 2005].

In the case of long-term projections, the basic meaning is associated with the planning of investments such as the development and maintenance of transmission networks, expansion of generation- fuel facilities, and to determine the scope of international cooperation [Piotrowski,Parol et.al.,2000]. Long-term forecasts are often linked with the expected economic development [Granger, Jeon 2007]. In addition to the forecast accuracy an important factor is proper assessment of the impact of macroeconomic conditions on the operation of the entities in the power sector. Particular attention should be given to the

opportunities of developing alternative energy sources and the development of technologies that are energy efficient.

3 Results of calculations for Nord Pool exchange

As an empirical example, day-ahead forecast for the Nord Pool exchange was conducted. Daily trading price from the period 1.01.2007-30.06.2011 were studied. Forecasting models have been developed based on four types of architectures of neural networks: multilayer perceptron (MLP), a network of radial basis functions (RBF), generalized regression network (GRNN), and a support vector machine network (SVM). As a quality indicator of forecasting results the Mean Squared Error (MSE) was chosen.

Results of analysis for MLP networks are shown in Figure 1.

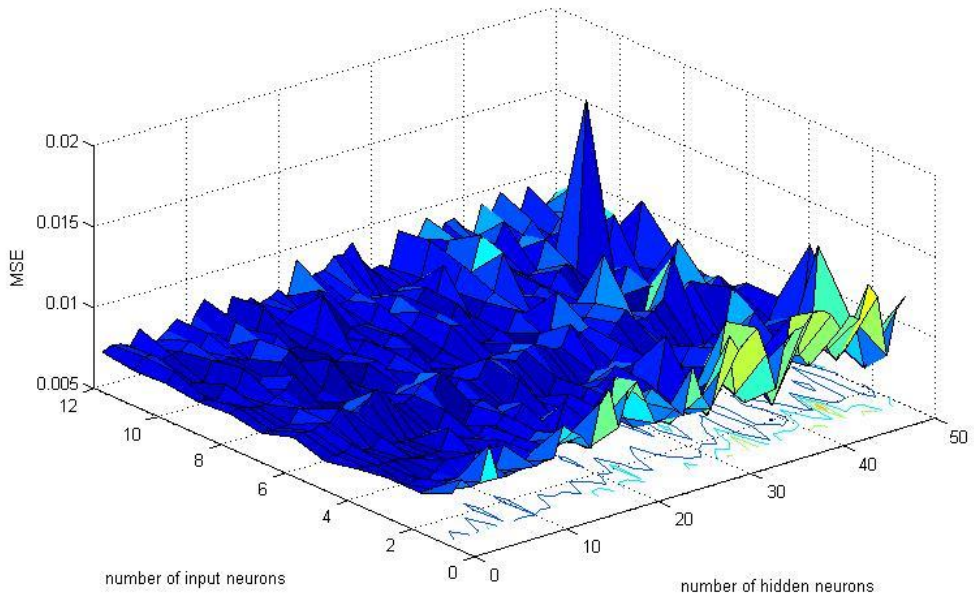

Figure 1 Error surface for MLP network

The increase in the number of neurons in the hidden layer above a certain threshold (in this case 30) does not contribute to improving the quality of forecasts, with even leading to their deterioration.

Area error testing for GRNN network is shown in Figure 2.

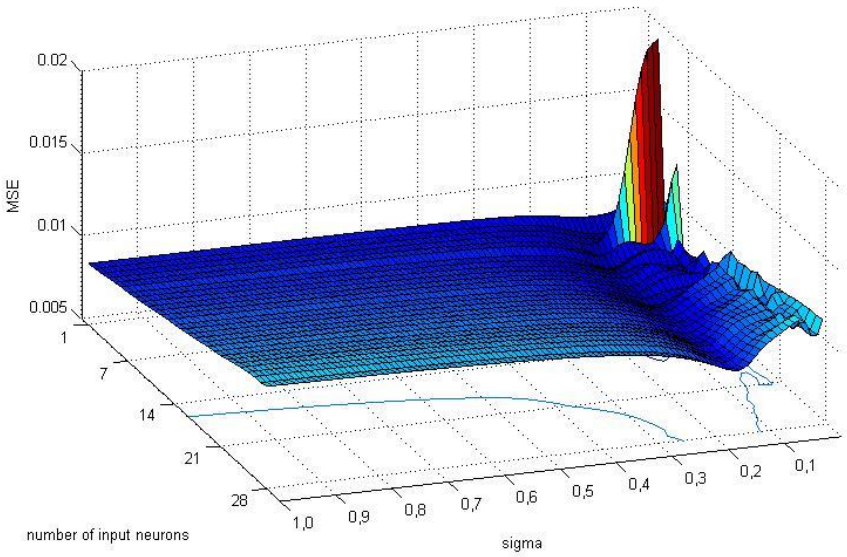

Figure 2 Error surface for GRNN network

For models based on GRNN networks characteristic phenomenon is the existence of a minimum of the error function for the parameter σ = 0,2. Another striking feature is the increase in forecast error with the number of input neurons. In this case, the larger order of the model does not imply improving the quality of forecasts.

Figure 3 shows the surface of the error function for RBF network testing.

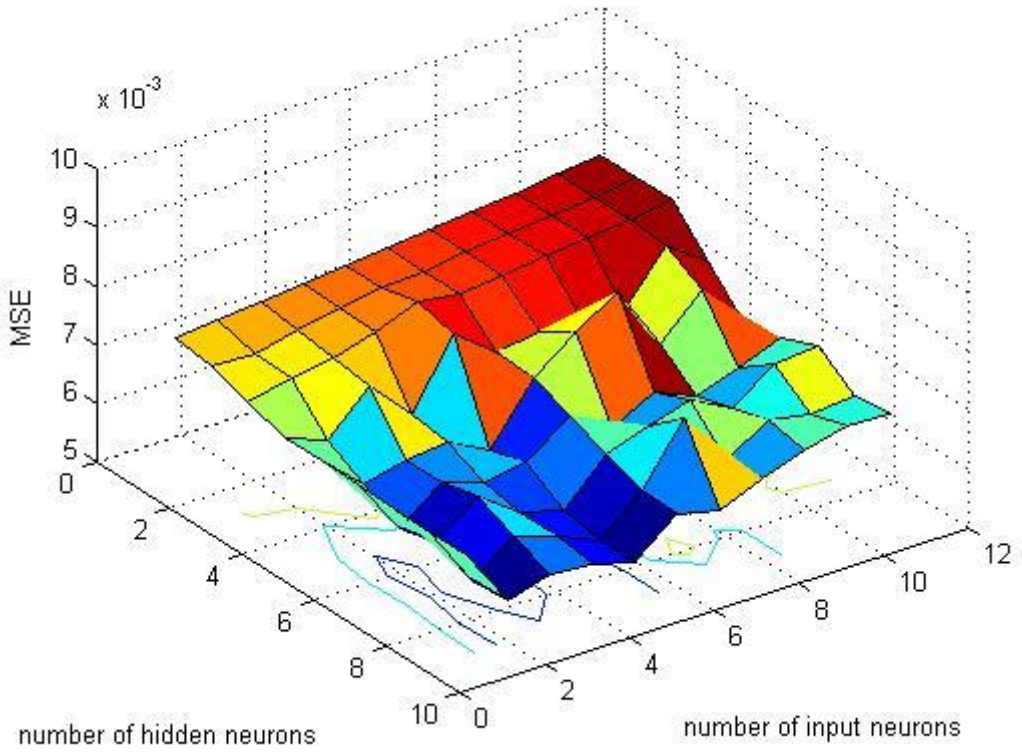

Figure 3 Error surface for RBF network

Distinctive features include the presence of many local minima. The best projection quality in that case exhibits models with 5 input neurons. The graph also shows the effect of decreasing the error with increasing the number of hidden neurons and the lack of improvement in the quality of predictions when using higher-order models. It should also be mentioned that at large number of hidden neurons RBF network learning algorithm may be divergent, making it impossible to train a network with a given structure

The relationship between size of the input vector and the MSE test error for SVM network is shown on the Figure 4.

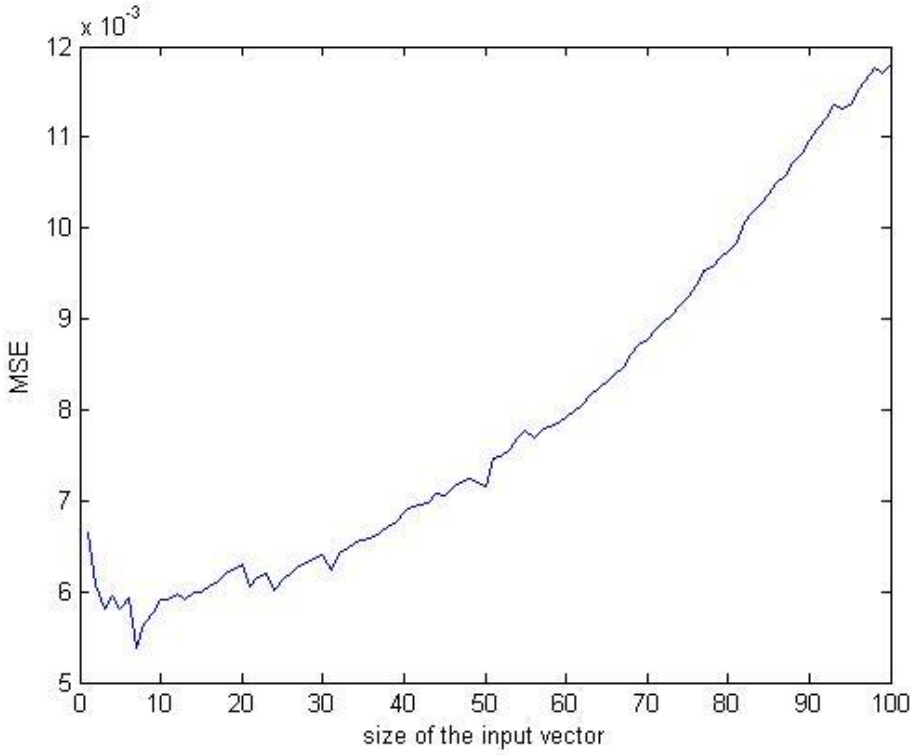

Figure 4 Plot of test error for SVM network

The characteristic feature is the occurence of a global minimum on the number of inputs equal to 7. Enlarging the number of inputs over this limit does not lead to the improvement of the quality of forecasts.

The errors obtained on the test sets with a particular models is shown on the Table 1. The best prediction error obtained prediction model based on the MLP network.

Table 1 The results of the best forecasting models

Network type	MSE
MLP	0,0032
RBF	0,0035
GRNN	0,0035
SVM	0,0049

The comparison between actual values and forecast results for MPL network is shown on the Figure 5.

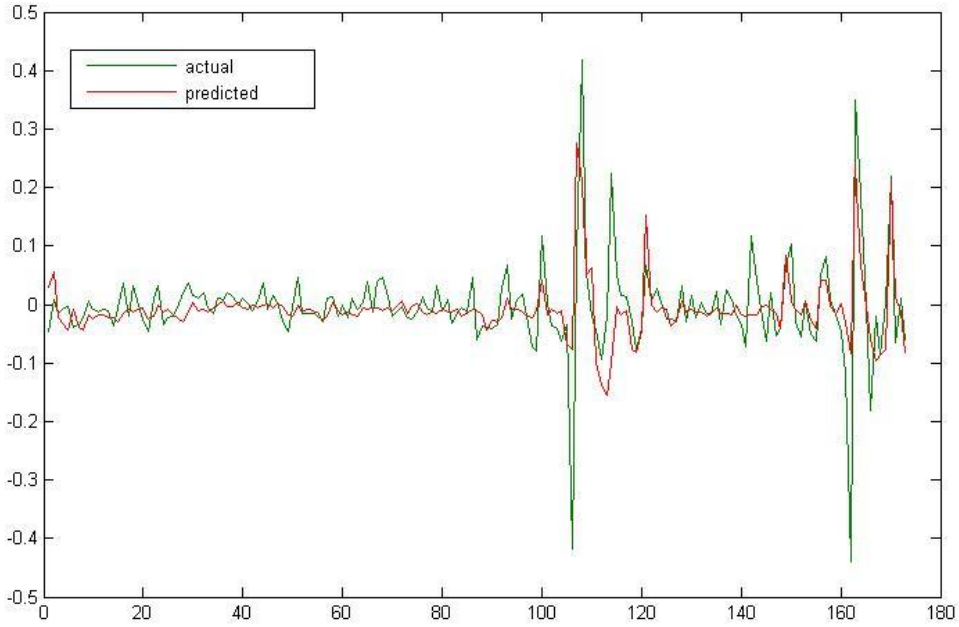

Figure 5 Actual price volatility versus predicted

The presented waveforms are evidence of a good model adaptability to changing amplitude of price fluctuations. An interesting feature is the inability to predict the strong, negative changes in prices. The growth changes are mostly predicted, but sometimes their amplitude is underestimated.

Multi Layer Perceptron network gained the smallest prediction error among all the studied types of networks. The forecast error of MLP network does not place this type in dominant position. The resulting advantage over other models is rather neglible.

5 Conclusions

The performed experiments lead to following conlusions:

1 Neural networks can be as a forecasting tools on energy exchanges.

2 The most suitable prediction model for Nord Pool exchange is MLP network due to the smallest prediction error

3 Test errors of different types of neural networks differ slightly.

4 Strong, negative price changes are generally not predictable.

Performed numerical experiments confirmed the ability of different types of neural networks to forecast voaltility of electricity prices on Nord Pool exchange. Thus, it has been proven that neural networks can be regarded as an instrument to improve the competitiveness of companies in the power sector. It is important, that use of mentioned methods is not related with high level of capital expedintures. This important feature tends to use artificial intelligence methods to enhance the competitive potential of enterprises.

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MODELLING AND FORECASTING OF EUR/USD EXCHANGE RATES

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ABSTRACT

We examine the ARIMA-ARCH type models for the forecasting of the EUR/USD exchange rate time series and make comparisons with the class of RBF neural network models. We found that it is possible to achieve significant risk reduction in managerial decision-making by applying intelligent forecasting models based on the latest information technologies. We show that statistical GARCH-class models can identify the presence of the leverage effect and to react to the good and bad news. In a comparative study is shown, that both presented modeling approaches are able to model and predict high frequency data with reasonable accuracy, but the neural network approach is more effective. We discuss certain management aspects of developing a good forecasting system mainly the ability to achieve optimal performance in the face of uncertainty. We also show how the proposed information technology contributes for the people who will make and at the some time use the forecast in financial institutions, companies, medium and small enterprises.

KEYWORDS

Time series, classes ARCH-GARCH models, volatility, forecasting, neural networks, cloud concept, forecast accuracy.

1 Introduction

In economics and in particular in the field of financial markets, forecasting is very important because forecasting is an essential instrument to operate day by day in the economic environment. In companies, medium and small enterprises, selecting an appropriate forecasting algorithms or methods is important in terms of forecast accuracy and efficiency. Therefore, it is important to search available information technologies to get optimum forecasting models.

Most statistical/econometric models assume linear relationship among variables in which the random errors are generally to be independent random variables with normal distribution and constant variance over the sample period. These limitations are reasons for the poor forecasting performance of these models. Every body is aware of the poverty of this approach. Nonlinearity seems to be a feature of economic phenomena that cannot be given up easily. In particular, in the monetary and financial markets, public announcements, monetary or financial decision and other political and economic events can create discontinuities and nonlinearities. A relatively new class of statistical models called ARCH (AutoRegressive Conditional Heteroscedastic) were introduced where the variance does depend on the past. Following fruitful applications of information and communication technologies (ICT) to predict financial data this work goes ahead by using ICT for modeling any non-linearities within the estimated variables. Besides regression or ARIMA (AutoRegressive Integrated Moving Average) models with disturbances following an ARCH type process the most popular applications for predicting financial data are neural networks and models based on machine learning.

In this paper, two novel forecasting models are proposed for EUR/USD exchange rate prediction. The first based on latest statistical methods makes use of ARIMA/GARCH-class

models, and another is the neural network based on the radial basic activation function that makes uses both supervised learning methods and un-supervised learning methods. Then, we discuss certain management aspects of proposed forecasting models such as capabilities and interests of the people who will make and use the forecast. in their decision processes.

The paper is organized in following manner. Section 2 deals with the methodology of ARCH/GARCH-family models and with neural networks considered for this paper. Data and methodology illustration on the developing forecasting models is presented in Section 3. The results of empirical analysis of both approaches are discussed in Section 4 Section 5 briefly concludes.

2 Theoretical Background

Traditional statistical/econometric models assume a constant one-period forecast variance. But, the financial time series features various forms of nonlinear dynamics, the crucial one being the strong dependence of the instantaneous variability of the series on its own past (Gouriéroux, 1997). To predict the financial time series data a regression model is used with disturbances following an ARCH type process.

2.1 Theoretical Background

Time series models have been initially introduced either for descriptive purposes like prediction or for dynamic control. In this paper we will use linear time series models so-called ARIMA which are very easy implement well-established methods for time series prediction. They combine autoregressive (AR), and moving average (MA) part. AR is a linear combination of previous values, 'I' is an operator for differencing a time series and MA is a linear combination of previous errors. An ARMA(p, q) model of orders p and q is defined by

$$y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + \ldots + \phi_p y_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \ldots + \theta_q \varepsilon_{t-q} \qquad (1)$$

where $\{\phi_i\}$ and $\{\theta_i\}$ are the parameters of the autoregressive and moving average parts respectively, and ε_t is white noise with mean zero and variance σ^2. We assume ε_t is normally distributed, that is, $\varepsilon_t \sim N(0, \sigma^2)$. ARIMA($p$, d, q) then represents the dth difference of the original series as a process containing p autoregressive and q moving average parameters. The method of building an appropriate time series forecast model is an iterative procedure that consists of the implementation of several steps. The main four steps are: identification, estimation, diagnostic checking, and forecasting. For details see Box and Jenkins (1976).

2.2 Asymmetric ARCH time series models

Among the field of applications where the standard ARIMA fit is poor are financial and monetary problems. Exchange rates, stock market returns and other macroeconomic variables of generally high frequency are likely to originate from low complexity chaos. Detection of nonlinear hidden pattern in such time series provides important information about their behavior and improves the forecasting ability over short time. In this context, ARCH (Autoregressive Conditionally Heteroscedastic) models introduced by Engle (1982) arose as an appropriate framework for studying these problems

The basic GARCH model can be extended to allow for leverage effects. This is performed by treating the basic GARCH model as a special case of the power GARCH (PGARCH) model proposed by Ding, Granger and Engle (1993)

$$\sigma_t^d = \alpha_0 + \sum_{i=1}^{p} \alpha_i (|\varepsilon_{t-i}| + \gamma_i \varepsilon_{t-i})^d + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^d \tag{2}$$

where *d* is a positive exponent, and γ_i denotes the coefficient of leverage effects (Zivot and Wang, 2005).

Commonly used asymmetric volatility models are the ARCH type models. Especially the TGARCH (threshold GARCH) and EGARCH (Exponential GARCH) models will be applied, which allows for leverage effects. TGARCH models divides the distribution of the innovations into disjunctive intervals and then approximate a piecewise linear function for the conditional standard deviation or the conditional variance respectively. However, a stylized fact of financial volatility is that bad news (negative shocks) tends to have a larger impact on volatility than good news (positive shocks). Nelson (1991) proposed the following exponential GARCH model abbreviated as EGARCH to allow for leverage effects in the form

$$\log h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \frac{|\varepsilon_{t-i}| + \gamma_i \varepsilon_{t-i}}{\sigma_{t-i}} + \sum_{j=1}^{q} \beta_j \log h_{t-j} \tag{3}$$

Note if ε_{t-i} is positive or there is "good news", the total effect of ε_{t-i} is $(1+\gamma_i)\varepsilon_{t-i}$. However contrary to the "good news", i.e. if ε_{t-i} is negative or there is "bad news", the total effect of ε_{t-i} is $(1-\gamma_i)|\varepsilon_{t-i}|$. Bad news can have a larger impact on the volatility. Then the value of γ_i would be expected to be negative (Zivot and Wang, 2005).

As we mentioned early, another extension of the clasic GARCH model that alows for leverage effect is the treshold GARCH. TGARCH models divide the distribution of the innovations into disjunctive intervals and then approximate a piecewise linear function for the conditional standard deviation or the conditional variance respectively. TGARCH models have therefore the following form:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \gamma_i S_{t-i} \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-j} \tag{4}$$

where $S_{t-i} = 1$ if $\varepsilon_{t-i} < 0$ and $S_{t-i} = 0$ if $\varepsilon_{t-i} \geq 0$.
Depending on the threshold value, ε_{t-1}^2 will have different effects on the conditional variance σ_t^2, as it follows: when ε_{t-1} is positive, total effects are given by $\alpha_1 \varepsilon_{t-1}^2$, when ε_{t-1} is negative, total effects are given by $(\alpha_i + \gamma_i)\varepsilon_{t-i}^2$.

2.3 Neural Approach

For the investigation with neural networks an RBF (soft, classic and granular) three layer feed-forward net is employed, where the output layer weight are trained by using backpropagation algorithm, whereas the hidden layer weights are found by a clustering algorithm applied to the input data which is an unsupervised learning technique. The transfer function in the hidden layer is a radial basic function, whereas for the output unit a linear transfer function is applied. Despite the fact that RBF neural networks possess a number of attractive properties such as the universal approximation ability and parallel structure, they still suffer from problems like the existence of many local minima and the fact that it is unclear how one should choose the number of hidden units. In order to avoid over-fitting and

data-fitting the networks are kept simple (the number of hidden units in varied between 3 and 10). For more details see Kecman (2001).

3 Data and Model Estimates

We illustrate the ARCH/ARCH methodology on the developing a forecast model for daily EUR/USD exchange rates time series. This time series was obtained from http://oanda.com/currency/historical-rates/ for period from 2001 till 2010, it includes total of 3652 observations. We have 10 years long time series of the closing rates of EUR/USD exchange rates (see Figure 1).

Figure 1. Time series of the daily exchange rates (2001 – 2010): EUR currency against the US dollar (USD).

The time series in Figure 1 exhibits non-stationary behaviour. However, after its first differencing is stationary. To build a forecast model the sample period (Jan 2001 – Oct 2010 training data set denoted A) was defined and the ex post forecast period (Nov 2010 – Dec 2010 as validation data set denoted E)

3.1 Statistical Approach

Input selection is crucial importance to the successful development of an ARIMA-ARCH model. Tentative identification of an ARIMA time series model is done through analysis of actual historical data. The primary tools used in identification process are autocorrelation and partial autocorrelation functions (ACF, PACF). According to these criterions, we tentatively identify the underlying model of our series to by stationary ARIMA(1, 1, 1) with the equation as follows

$$\Delta y_t = \phi_1 \Delta y_{t-1} + \phi_1 \varepsilon_{t-1} + \varepsilon_t \tag{5}$$

where Δ is the difference operator defined as $\Delta y_t = y_t - y_{t-1}$.

As we mentioned early, high frequency financial data, like our EUR/USD exchange rate time series, reflect a stylized fact of changing variance over time. An appropriate model that would account for conditional heteroscedasticity should be able to remove possible nonlinear pattern in the data. Various procedures are available to test an existence of ARCH or GARCH. A commonly used test is the LM (Lagrange Multiplier) test. The LM test assumes the null hypothesis H_0: $\alpha_1 = \alpha_2 = ... = \alpha_p = 0$ that there is no ARCH. The LM statistics has an asymptotic χ^2 distribution with p degrees of freedom under the null hypothesis. For calculating the LM statistics see for example Engle (1982), Nelson (1991). The LM test

performed on the EUR/USD exchange rates indicates presence of autoregressive conditional heteroscedasticity.

Parameter estimates were obtained by ML (Maximum Likelihood) method using the R2.6.0 software. Our final model has the form

$$\Delta\hat{y}_t = 0.000126\Delta y_{t-1} 0.041943\varepsilon_{t-1} \tag{6}$$

for mean equation, and

$$h_t = 2.46.10^{-7} + 0.030278\, y_{t-1}^2 + 0.969150 h_{t-1} \tag{7}$$

for GARCH(1,1) model with GED distributions.

Finally to test for nonlinear patterns in EUR/USD exchange rates the fitted standardized residuals $\hat{\varepsilon}_t = e_t / \sqrt{h_t}$ were subjected to the BDS test. The BDS test (at dimensions N = 2, 3, and tolerance distances ε = 0.5, 1.0, 1.5, 2.0) finds no evidence of nonlinearity in standardized residuals of the EUR/USD exchange rates time series. The fitted vs. actual EUR/USD exchange rates for the validation data set are graphically displayed in Figure 2.

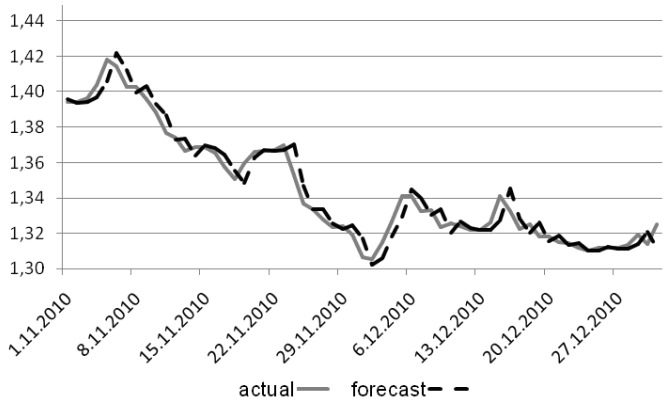

Figure 2. Actual (solid) and forecast (dotted) values of the EUR/USD exchange rate forecast - statistical alternative, model ARIMA(1,1,1) + GARCH(1,1).

3.2 Neural Approach

In this section we show a relatively new approach of function estimation for time series modelled by means a granular RBF neural network based on Gaussian activation function modelled by cloud concept (Li,, and Du, 2008) and by SVR method. We proposed the neural architecture according to Figure 3. This neural network computes the output data set as

$$\hat{y} = G(\mathbf{x}_t, \mathbf{c}, \mathbf{v}) = \sum_{j=1}^{s} v_{j,t}\, \psi_2(\mathbf{x}_t, \mathbf{c}_j) = \sum_{j=1}^{s} v_j o_{j,t} \qquad t = 1, 2, ..., N) \tag{8}$$

where v_j are the trainable weights connecting the component of the output vector $\mathbf{o}$. $\psi_2(./.)$ in Eq. (8) has the form

$$\psi_2(\mathbf{x}_t, \mathbf{c}_j) = \exp\left[-(\mathbf{x}_t - \mathrm{E}(\mathbf{x}_j)/2(En')^2\right] = \exp\left[-(\mathbf{x}_t - \mathbf{c}_j)/2(En')^2\right] \tag{9}$$

where $\mathbf{c}_j$ represent the centres of activation functions in the hidden layer, En' is a normally distributed random number with mean *En* and standard deviation *He*, E is the expectation operator (see Figure 2 right). This neural network is called as granular RBF neural network (G RBF NN) (Marcek, M., Marcek, D.,2008).

The G RBF NN was trained using the variables and data sets as the ARIMA(1,1)) + GARCH(1,1) model above. In G RBF NN, the non-linear forecasting function $f(\mathbf{x})$ was estimated according to the expressions (8) with RB function $\psi_2(./.)$ given by equation (9). The detailed computational algorithm for ex post forecast RMSE values and the weight update rule for the granular network is shown in (Marcek, M., Marcek, D.,2008).

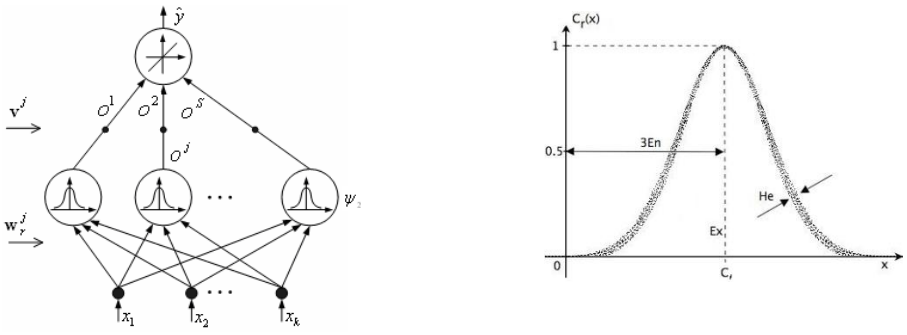

Figure 3. The G RBF neural network architecture (left) and the description of activation functions ψ_2 in the hidden layer neurons by Gaussian cloud concept (right).

The RBF NN was trained using the variables and data sets as the ARIMA(1,1))+GARCH(1,1) model above. In G RBF NN, the non-linear forecasting function $f(\mathbf{x})$ was estimated according to the expressions (8) with RB function $\psi_2(./.)$ given by (9). The detailed computational algorithm for ex post forecast RMSE values and the weight update rule for the granular network is shown in (Marcek, M., Marcek, D.,2008). The fitted vs. actual EUR/USD exchange rates for the validation data set are graphically displayed in Figure 4.

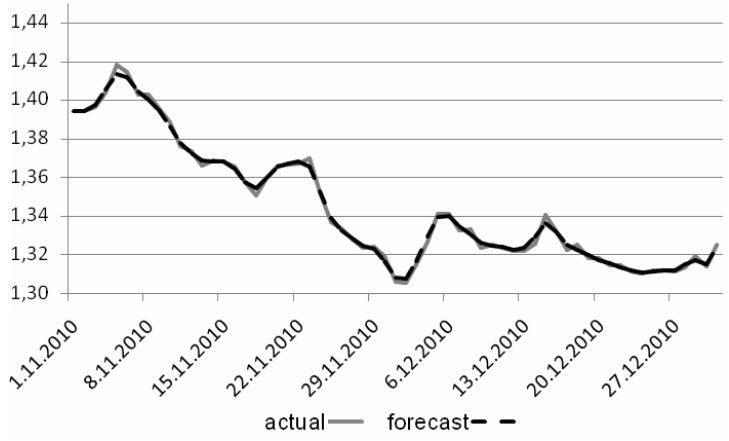

Figure 4. Actual (solid) and forecast (dotted) values of the EUR/USD exchange rate forecast (neural approach).

4 Empirical Comparison and Discussion

Table 1 presents the summary statistics of each model based on RMSE, MAE, MAPE calculated over the validation data set (ex post period). From Table 1 it is shown that both forecasting models used are very accurate. The development of the error rates on the validation data set showed a high inherent deterministic relationship of the underlying variables. Though promising results have been achieved with both approaches, for the chaotic financial markets a purely linear (statistical) approach for modeling relationships does not reflect the reality. For example if investors do not react to a small change in exchange rate at

the first instance, but after crossing a certain interval or threshold react all the more, then a non-linear relationship between Δy_t and Δy_{t-3}, ε_{t-1} exist in model (5).

Table 1. Comparison of forecast summary statistics for EUR/USD exchange rate time series - statistical and neural approach: ex post period.

Model Model´s forecast accuracy:	RMSE	MAE	MAPE
ARIMA(1,1,1) + GARCH(1,1) statistical approach	0.00793	0.00646	0.00495
Neural approach (G RBF NN) Inputs: Δy_{t-1}, ε_{t-1} Number of hidden layer neurons: 10	0.00185	0.00145	0.00107

The training process and development of neural approach based on G RBF NN not only detected the functionality between the underlying variables as well as the short-run dynamics. Moreover, as we could see, the RBF NNs have such attributes as computational efficiency, simplicity, and ease adjusting to changes in the process being forecast. Thus, neural networks are usually used in the complicated problems of prediction because they minimize the analysis and modeling stages and the resolution time. In our case, they omit diagnostic checking, significantly simplify estimation and forecasting. Thus, we can expect more interests of the people who will make and at the some time use the forecast. If the managers are convinced that the forecasting system is sound and, they may make little use of the information given to them. ARCH-GARCH models require more costs of development, installation and operation in a management system, management comprehension and co-operation, and often a lot of computational time. Another disadvantage of ARCH-GARCH models is that there is not a convenient way to modify or update the estimates of the model parameters as each new observation becomes available. One has to periodically completely develop and refit the model. There are not efficient methods for algorithmic estimating the measures of forecasting accuracies and responsiveness properties. As mentioned in Montgomery et al. (1990), a serious drawback of ARIMA-GARCH models is the investment in time and other resources required to build a satisfactory model. It is doubtful that improvements in forecast accuracy possible through ARCH-GARCH modelling methodology could justify the cost of the model-building process. As we illustrated, improving forecast accuracy by advanced information technologies will reduce uncertainty, where the added refinement can be economically justified.

5 Conclusion

In managerial decision-making, risk uncertainty are the central categories based on which the effects of individual variants are assessed, and subsequently the final decision is chosen from several variants. In the present paper we proposed two approaches for predicting the EUR/USD exchange rate time series. The first one was based on the latest statistical ARCH-GARCH methodologies, the second one on neural version of the statistical model.

After performed demonstration it was established that forecasting model based on RBF neural network approach is better than ARIMA/ARCH one to predict high frequency financial data in the EUR/USD exchange rate time series.

The direct comparison of forecast accuracies between statistical ARCH-GARCH forecasting models and its neural representation, the experiment with high frequency financial data indicates that both methodologies yield very little MAPE (Mean Percentage Absolute

Error) values. Moreover, our experiments show that neural forecasting systems are economical and computational very efficient, well suited for high frequency forecasting. Therefore they are suitable for financial institutions, companies, medium and small enterprises.

The results of the study showed that there are more ways of approaching the issue of risk reducing in managerial decision-making in companies, financial institutions and small enterprises. It was also proved that it is possible to achieve significant risk reduction in managerial decision-making by applying modern forecasting models based on information technology such as neural networks developed within artificial intelligence. In future research we plan to extend presented methodologies by applying fuzzy logic systems to incorporate structured human knowledge into workable learning algorithms.

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BUSINESS INTELLIGENCE AS A KEY FOR THE SUCCESS OF THE ORGANIZATION

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ABSTRACT

The paper concerns the Business Intelligence (BI) that is that most significant research area for the last years. The research study is mainly exploratory and descriptive in nature, with the objective of providing an overview of the issue of BI and BI using in organizations. Some findings from the survey that was conducted in 20 purposefully selected organizations have been presented. Finally, some guidelines and recommendations have been indicated in order to improve the using of BI in organizations.

KEYWORDS

Business intelligence, big data, organization

1. Introduction

The information, knowledge and consequently intelligence have become very important resources of a contemporary organization (Adelman, Moss, 2000; Alter, 2004; Karim, 2011; Olszak, 2007; Wells, 2011). It is highlighted that its success depends more and more from the ability to take advantage of all available information (Davenport, Harris, 2007; Shick, Frolick, Ariyachandra, 2010). This challenge becomes more difficult with the constantly increasing volume of information. Last years many organizations turn to Business Intelligence (BI) (Clavier, Lotriet, Loggerenberger, 2012; Liautaud, Hammond, 2002; Olszak, 2012; Watson, Wixom, 2007). It is reported that BI is the most significant research areas for the last years (Chen, Chiang, Storey, 2012; Jurdan, Rainer, Marschall, 2007).

According to many authors BI has become the critical component for the success of the contemporary organization (Weiss, 2002; Williams, Williams, 2007; Howson, 2008; Wixom, Watson, 2010). It enables to take competitive advantage of all available information (both internal and external), provides actionable intelligence for effective business decision-making and business processes (Albescu, Pugna, Paraschiv, 2008; Baaras, Kemper, 2008; Chung, Chen, Nunamaker, 2005; Venter, Tustin, 2009).

It is highlighted that BI focused on the analysis of external information resources has become more important. The analysis of internal resources for the success of the contemporary organization is not enough. However, an understanding of analyzing of external resources for the success of the organization is only partly addresses by existing research. Some authors describe the examples of international organizations that compete and take competitive advantage trough BI using external information resources (Azvine, Cui, Nauck, 2005; Shick, Frolick, Ariyachandra, 2010; Wixom, Watson, 2010). Unfortunately, they are rather rare, especially within polish business context. Additionally, the IT solutions designed to address this challenges have been developed to analyze internal information and to support mainly internal business processes. In a small degree they are focused on the analysis of external environment, enabling the transforming information about competitors and customers into strategic knowledge and competitive advantage. It is considered that for the sustainable success of the organization comprehensive approach to BI is needed. It should be focused on the analysis both internal and external information resources. The first approach is associated with traditional ERP systems, data warehouse, data marts, OLAP, traditional data mining. The

second approach is associated with big data, social media, web analytics, network analytics, and mobile analytics.

The main purpose of this paper is to explore the issue of BI and to investigate of BI using in the selected organizations. The reminder of the paper is organized as follows. Firstly, on the ground of resource - base view, the issue and evolution of BI was explained. Next, the role of big data for the business analysis was explored. Some selected findings from the survey that was conducted in 20 purposefully selected organizations have been presented. Finally, some guidelines and recommendations were provided in order to improve the using of BI for the organizational success.

2. Literature Review

Resource-based View

According to many authors organizational knowledge and business intelligence are a crucial bundle of intangible resources that can be the source of a success and competitive advantage (Davenport, Harris, 2007; Herschel, Jones, 2005; McGonagle, Vella, 2002; Moss, Alter, 2003; Negash, Gray, 20080.

Resource-based View (RBV), a well-known theory of strategy argues that organizations with valuable, rare, inimitable and non-substitutable resources have the potential of achieving superior performance (Barney, 1995). In an extended approach of RBV resources implies intangible categories including organizational, human and networks (Ahn, York, 2011). This knowledge-based resource approach of RBV encourages organizations to obtain, access, and maintain intangible endowments because these resources are the ways in which firms combine and transform tangible input resources and assets (Wiklundi, Shephered, 2003). Furthermore, intangible resources are more causally ambiguous and less observable than tangible resources, therefore, it is not easy for competitors to duplicate. To provide sustainable competitive advantage, resources should be (Cosic, Shanks, Maynard, 2012): valuable (enable an organization to implement a value-creating strategy), rare (are in short supply), inimitable (cannot be perfectly duplicated by rivals), non-substitutable (cannot be countered by a competitor with a substitute).

The RBV conceptualizes organizational resources as static, neglecting changes due to turbulent environments. Dynamic capabilities were conceptualized in response to this criticism. Dynamic capabilities focus on ‘resource renewal’: reconfiguring and renewing resources into new organizational capabilities (Teece, Pisano, Shuen, 1997). They comprise two organizational routines: search and select and asset orchestration (Helfat et al., 2007). In the context of BI, search and select involves the identification of new BI-enabled business opportunities (search) and prioritizing them (select). Asset orchestration involves implementing newly selected BI-enabled business opportunities and creating new combinations and co-alignments of assets.

Business Intelligence evolution

The exploration and analysis of the literature show that there is no commonly accepted term of Business Intelligence (Clavier, Lotriet, Loggerenberger, 2012; Olszak, 2013). For the purpose of this study it is assumed that BI is a broad category of technologies, applications, and processes for gathering, storing, accessing, and analyzing data to help users make better decisions (Wixom and Watson, 2010).

According to many authors the role of BI and its impact on organizations and the whole society has been changed (Clavier, Lotriet, Loggerenberger, 2012). It is reported that there are distinguished 3 ages in the development of BI. They are called: BI 1.0, BI 2.0, Bi 3.0

The first age of BI, called BI 1.0. falls on seventies and eighties of XX century. It is closely related with the management information systems (MIS), executive information systems (EIS), and decision support systems (DSS) (Turban et al., 2008; Watson and Wixom, 2010). The technologies and applications commonly used in information systems were grounded in basic statistical methods and simple data mining techniques. Analysed data were mostly structured, collected by companies through various legacy systems and often stored in commercial relational database management systems. Data management and regional warehousing is considered the foundation of BI 1.0. Data marts and ETL tools are essential for converting and integrating enterprise-specific data. Database query, OLAP, reporting tools were used to explore important data characteristics. Business performance management using scorecards and dashboards help analyse and visualize a variety of performance metrics (Chen, Chiang, Storey, 2012). Generally, the first BI applications from this age were able to process the simple tasks for operational and tactical management. They were characterized by production the simple reporting. Individual reports were written by expert programmers. It is reported that BI 1.0 was focused on "delivery to the consumer" and market leaders include: SAS, IBM (Gratton, 2012).

Table 1: The Characteristics of 3 ages of Business Intelligence
Source: Elaborated on: (Chen, Chiang, Storey, 2012; Gratton, 2012).

	BI 1.0 (Tool-centricity)	BI 2.0 (Web-centricity)	BI 3.0 (Application-centricity)
Content	DBMS-based structured content	Web-based, unstructured content, Web technology	Mobile and sensor-based content
Foundational technologies	DBMS, ERP, OLAP, data warehousing, data mining	Web services, search engines, web mining, web visualization, information semantic services, natural language question answering	Cloud services, social search and mining, smartphone platforms, mobile web services, spatial mining
User interface	Client	Web	Multi-device
Design priority	Capability	Scalability	Usability
Functionality	Aggregate and present	Explore and predict	Anticipate and enrich
Frequency/detail	monthly/detailed	weekly-daily-summary	Real-time/processes
Client use case	Operational reconciliation	Enterprise alignment	Social empowerment
Insight scope	Mile deep inch wide	Mile wide inch deep	Outcome-specific
Uptake/reusability	<1%/limited	<15%/some	>25%/entire application
Foundational Influences	Delivery only	Creation & delivery	Creation, delivery & management

The second age of BI (1990-2005) - is associated with father development of advanced data warehouses, OLAP techniques, data mining and first of all with Internet and web technology (web search engines such as Google, Yahoo etc.) These technologies allow organizations to present their business online and interact with their customers directly. Text and web analytics are commonly used to process and analyze unstructured web contents. The many Web 2.0 applications have also created an abundance of user-generated content from various online social media such as forums, online groups, web blogs, social networking sites, social media sites and even virtual worlds and social games (Doan et al., 2011). BI 2.0 has evolved into solutions that can be used in strategic planning, predictive modelling, forecasting, monitoring operations, and studying the profitability of products (Negash, Gray,

2008). It is highlighted that BI 2.0 is focused on "creation and delivery for consumers" and market leaders include: Business Objects, Cognos, Hyperion, Microsoft, Teradata, Oracle.

BI 3.0. presents a new era in the evolution of BI. Thanks to web and mobile devices (iPad, iPhone, and other sensor-based Internet-enabled devices equipped with RFID, barcodes, radio tags.) it appears possibility to create innovative applications, and intelligent business network for everyone. There is a growing acceptance of the idea that analysis is a collaborative (not only singular) and social effort. It focuses on a collaborative workgroups (which are self-regulated) and on information outcomes within the confines of core business interaction with customers, employees, regulators etc. There is common sense that BI 3.0 should go beyond reliance on structured data available in internal sources but should use also external, mostly unstructured data in various formats (social media posts, free form web content, images, and video files) (Nemec, 2012). BI 3.0 is concentrated on "creation, delivery and management for consumers" (Gratton, 2012). According to Scott (2013) there are 5 core attributes that support BI 3.0 philosophy: proactive, real-time, integrated with business processes, operational (available to line workers), and extended to reach beyond the boundaries of the organizations to improve information delivery and decision support functionality for all. It is indicated also that there is no reason to depreciate in BI 3.0 the functions (known from BI 2.0) like: reporting, OLAP, data mining. They have still their strong position. BI 3.0 philosophy is to raise the added value of BI tools' architecture by anchoring collaborative style of information search and analysis with intuitive and self-service user interface that delivers timely and highly relevant insights to anyone who is properly authorized and needs them (Nemec, 2012). According to Chatter (2013) there are 3 prerequisites for software tools to be recognized as a BI 3.0 tools: be social, relevant (automatically delivers relevant insights that users really need according to their situation and user profile), fully self-service (intuitiveness).

Different BI models during the evolution of BI have been developed (table 2). They were focused, firstly on single users or small groups of users (with simple static reporting), then on the whole organization (with corporate data warehouse and predictive analysis), ending on BI nets and customized BI (BI for everyone). The description of different BI models is presented in the table 2.

Table 2: The description of different BI models, source: (Olszak, 2007).

Type BI	Function	Scope	Decision support level	Used techniques
Data Marts	Ad hoc analysis, comparative analysis, reporting	Narrow, limited to unit, department (sale)	Operational, well structured	Simple, static reporting, OLAP
Data warehouse	Multidimensional analysis	The whole enterprise	Operational, tactical, strategic	OLAP, data mining
BI with PA	Forecasting of different scenarios	Narrow, limited to unit, department (sale)	Operational, tactical, strategic	OLAP, AP
Real-time BI	Monitoring of current activities discovering irregularities	Narrow, limited to unit, department (sale)	Operational, well structured	EII
Corporative BI	Corporative management, building loyalty strategy	All actors of value chain	Operational, tactical, strategic	ETL, data mining
BI portals	Content	Selected	Operational, tactical,	Internet, Web mining,

	management and document management, group work	communities	strategic	CMS, work group, personalization techniques
BI nets	The building of expert' nets, social capital management	Global, various communities	Operational, tactical, strategic	Web mining, Web farming
BI for everyone	The building of social nets, social capital management	Global,	Operational, tactical, strategic	Mobile, social media, semantic Web, Web mining

External information resources and big data

It is hard not to notice that external information resources and big data become more important in the development of BI systems. Big data (mostly unstructured information about competitors and customers) analyzed in combination with traditional enterprise data (most structured and semi-structured), enable organizations not only to better understand their business, but first of all to change it and to have new sources of revenues, more stronger competitive position and greater innovation.

"Big data" refers (Manyika et al., 2011) to datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyze. It is noted that this definition can vary by sector, depending on what kinds of software tools are commonly available and what sizes of datasets are common in a particular industry. According to Ferguson (2012) a term "big data" is "associated with the new types of workloads and underlying technologies needed to solve business problems that we could not previously support due to technology limitations, prohibitive cost or both. Big data is therefore not just about data volumes but about analytical workloads that are associated with some combination of data volume, data velocity and data variety that may include complex analytics and complex data types. Therefore big data can be associated with both structured and multi-structured data and not just the latter".

According to (Oracle, 2013) big data typically include the following types of data:

- traditional enterprise data – includes customer information from CRM systems, transactional ERP data, web store transactions, and general ledger data;
- machine-generated /sensor data – includes Call Detail Records ("CDR"), weblogs, smart meters, manufacturing sensors, equipment logs (often referred to as digital exhaust), trading systems data;
- social data – includes customer feedback streams, micro-blogging sites like Twitter, social media platforms like Facebook.
- It is highlighted that there are four key characteristics that define big data (Oracle, 2013):
- volume - machine-generated data is produced in much larger quantities than non-traditional data;
- velocity - social media data streams – while not as massive as machine-generated data produce a large influx of opinions and relationships valuable to customer relationship management;
- variety - traditional data formats tend to be relatively well defined by a data schema and change slowly. In contrast, non-traditional data formats exhibit a dizzying rate of

change. As new services are added, new sensors deployed, or new marketing campaigns executed, new data types are needed to capture the resultant information;

- value - the economic value of different data varies significantly. Typically there is good information hidden amongst a larger body of non-traditional data. The challenge is identifying what is valuable and then transforming and extracting that data for analysis.

Business Intelligence the key driver for the success of the organization

The great expectations are set for BI. BI is constantly ranked as top priority global. Nearly 90% of organizations across the globe have invested in a BI capability, bringing BI's annual global outlay to around USD$60 billion (Clavier, Lotriet, Loggerenberg, 2012). It is reported that the beneficiaries of BI include a wide group of users, representing trading companies, insurance companies, banks, financial sector, health sector, telecommunications, manufacturing companies, government, security and public safety. It is assumed that organizations use BI for (Olszak, 2013; Davenport, Harris, 2010; Hawking, Foster, Stein, 2008; Chaudhary , 2004):

- increasing the effectiveness of strategic, tactic and operational planning including first of all: (a) modelling different variants in the development of an organization; (b) informing about the realization of enterprise's strategy, mission, goals and tasks; (c) providing information on trends, results of introduced changes and realization of plans; (d) identifying problems and 'bottlenecks' to be tackled; (e) providing analyses of "the best" and "the worst" products, employees, regions; (f) providing analyses of deviations from the realization of plans for particular organizational units or individuals; (g) and providing information on the enterprise's environment;
- creating or improving relations with customers, mainly: (a) providing sales representatives with adequate knowledge about customers so that they could promptly meet their customers' needs; (b) following the level of customers' satisfaction together with efficiency of business practices; (c) and identifying market trends;
- analysing and improving business processes and operational efficiency of an organization particularly by means of: (a) providing knowledge and experience emerged while developing and launching new products onto the market; (b) providing knowledge on particular business processes; (c) exchanging of knowledge among research teams and corporate departments.

The most used BI analysis refer to: cross selling and up selling, customer segmentation and profiling, parameters importance, survival time, customer loyalty and customer switching to competition, credit scoring, fraud detection, logistics optimizations. Others concern: the forecasting of strategic business processes development, analysis of web mining, and social media.

Unfortunately, not all organizations relies major business value from their BI investments. The analysis of BI using shows that practical benefits are often unclear and some organizations fail completely in their BI approach. Even organizations reported to be benefiting from BI are on the lookout for opportunities to excel further and overcame challenges (Clavier, Lotriet, Loggerenberg, 2012).

The analysis of different BI systems allow to state that the most important elements that decide on the their success in the organizations include: quality of data and used technologies, skills, sponsorship, alignment between BI and business, and BI use (Clavier,

Lotriet, Loggerenberg, 2012). Others elements concern: organizational culture, information requirements, politics.

3. Research Methodology

The research questions I ask in this study refer to: the purpose of BI using, and some benefits from BI using. The study was of qualitative nature and was based on: (1) a critical analysis of literature, (2) a observation of different BI initiatives undertaken in various organizations, (3) semi-structured interviews conducted in purposefully selected polish organizations in 2012. Five elements (data, skills, sponsorship, alignment between BI and business, and BI use) considered to be the most important for the BI success, were used to assess BI in organizations. Some interviews, conducted in 20 polish organizations, were held with over 80 responders: executives, senior members of staff, and ICT specialists They represented the service sector: telecommunications (T)-4, consulting (C)-4, banking (B)-4, insurance (I)-4, marketing agencies (MA)-4. All of them had at least 5 years of experience in BI. Interviewees were selected on their involvement in BI or on their ability to offer an insight based on experience in BI and related decision support systems. The survey was conducted among purposefully selected firms (in Poland) that were considered to be advanced in BI.

The research was conducted within wider research project "Using BI tools in polish enterprises" and partly within project devoted to "Using software tools in Polish add Czech border region" (CZ.3.223.2.0412.02994). Presented survey is one the few studies that have been conducted in the Department of Business Informatics at the University of Economics in Katowice (Olszak, 2013). The limitation of this paper allowed to present only some selected findings.

4. Findings and Discussion

The responders in surveyed organizations were asked about the answering different questions that concerned among others: the understanding the term of BI, using BI (what BI models are used and what areas are supported by BI), BI strategy, quality of data, motivation to use BI, sponsorship, BI skills and some benefits from using BI.

The observations and conducted interviews in surveyed organizations allow to state that the organizations use BI systems first of all to optimize operational decisions, improvement of internal business processes and decision making on operational level and to better access to data and static reporting. The majority of the organizations use internal information resources and information systems like: ERP, MRP II, CRM and operational systems. BI applications are used to customer relationship management, identification of sales and inventory, optimization orders, marketing companions. Most of the organizations indicated the benefits from using BI like: integrated analysis for finance, marketing; improvement of decision making on operational and tactical levels of management and the possibility of demand forecasting. Unfortunately, only one organization (in conducted survey) in a professional way was able to monitor and process information about their competitors, suppliers and customers. Then, such information was converted into knowledge and consequently made use of gathering intelligence in decision process. Unfortunately, only a few enterprises saw benefits from the analysis of the whole environment that leads to competing on BI, new ways of doing business. The surveyed organizations do not build the social nets and manage social capital. They are still in the age of BI 2.0 and some of them can be classified on the BI 1.0 stage. The more detailed analysis of the obtained findings was presented in the table 3.

Table 3: Selected findings from using BI in surveyed organizations

Level	Very Low	Low	Medium	High	Very high
Data and used technology	Data incomplete, inconsistent, data overload, not integrated information systems	data bases, regional data warehouses, first OLAP, data marts, static reporting	The first efforts of converting information into intelligence, data mining, advanced reporting, ad-hoc analysis, dashboards, ERP, CRM, SCM	Corporate data warehouses, social media, social media data bases, social portals analysis of web logs	Mobile webs, personalization and behavioral modeling, mobile visualization/HCI
Skills	Decision-making based on intuition	Users know the basic internal business processes and partly some technical aspects of BI, simple analysis	Users know the both internal business processes (metrics) and some external business processes, know how to ask the right questions, how to navigate complex BI data structures, OLAP, data mining	Integrated view on organizations and their resources, corporate culture, users make advanced, integrated analysis, soft skills, high educated users in BI	Users convert results obtain form BI analysis in competitive advantage, new products, services, dynamic capabilities, sharing the knowledge among the members of the team, open communication, BI communities, trust in BI of all users
Sponsor-ship	In limited scope	Analytics, mangers, Leadership does not understand BI complexity	Senior executives	Support of CEO	Strong support of CEO
Alignment between BI and business	The classic gap between BI, IT and business	BI used for supporting selected operational and tactical decisions	Process-oriented culture, BPM, improving business processes	Defined BI strategy, supporting operational, tactical and strategic decisions	BI as a key driver for the success and taking the competitive advantage, new model of running the business, new products and services
BI use	BI focused on small group of users, selected departments	Internal business processes	BI focused on the whole organization, ERP	External business processes, CRM, SCM	Analytical, dynamic capability, social media, BI communities, social communities
Surveyed organizations	None	1C, 2I, 1B, 1MA, 1T	1MA, 3C, 2I, 1B, 2T	1T, 2B, 1MA	1MA

5. Conclusions and Implications

The obtained results from the conducted survey allow to state that the organizations are still concentrated first of all the analysis of internal resources. To obtain the organizational success with BI it is needed to acquire and process data that come from external environment. The organizations should be more focused on a strong, open communication and corporate culture, in which BI and knowledge are exchanged and such exchanges are warded. All users should be constantly educate in BI and have strong support from the senior executives and CEO. The understanding the philosophy of business intelligence (based on internal and external information resources) and knowledge management is required. The organizations should strong work with suppliers, to interoperate customer benefits into product and service specifications and investigate in public relations for key stakeholders.

The obtained findings provide the first implications to organizations in emerging countries, or at least companies in Poland. The organizations need to cultivate knowledge management and business intelligent capabilities in order to take the competitive advantage. The study findings recommend managers to start building their knowledge assets, which can bring to sustainable competitive advantages.

6. Limitations and Directions for Future Research

This study suffers from limitations despite insights grained through our study results. First, generalizability is not justified because the findings are based only on 20 organizations in Poland. Second, this research was conducted in purposefully selected organizations considered to be advanced in BI. Third, the survey was based on semi-structured interview conducted by the author. Using multiple informants might be recommended for further research.

Future research might take some of the following directions. First, it would be valuable to examine full multidimensionality of building the success through BI including information management, planning, implementation, and control. Second, further research might explore the detailed paths of building the organizational success through BI. Lastly, further empirical investigations and precise validations are invited to explore the associations between BI capabilities and strategic orientations, especially in varied economic domains.

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THE MAIN PROBLEMS AND PERSPECTIVES OF ECONOMY INTELLECTUALIZATION DEVELOPMENT IN UKRAINE

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ABSTRACT
The results of the theoretical and methodological aspects of the intellectualization as an economical process are presented. The investment securing of the Ukrainian economy intellectualization are analyzed. Recommendations for the development process of intellectualization as a process that affects innovation are considered.

KEYWORDS
Economy intellectualization, investment securing, knowledge, innovational activity

1. Introduction

Intellectualization of the economy is one of the major trends in today's economy and the factors that influence economic growth. One of its manifestations is to stimulate innovative activity. This should be considered in the process of development and implementation of the state policy in the sphere of economic growth. Accordingly, there is an important scientific problem: principles of economy state regulation in Ukraine, nominally aimed at promoting economic growth is not enough to account for the current world trends. This leads to the inhibition of economic growth. To solve this problem, it is necessary to clearly define the role of intellectualization of the economy under the condition of economic growth and establish its theoretical and methodological base. Research results confirmed that a high level of economic growth is not possible without proper investment of economy intellectualization as a set of measures to regulate the flow of investments and the implementation of a direct investment in the creation, transfer and commercialization of the knowledge gained in the market, in the form of innovation.

Therewith, in spite of Ukraine's economy current state of development, especially in the sphere of science and higher education, which fundamentally does not improve, despite the considerable number of publications and research results on the above mentioned problem, we can conclude that we need a new, effective approach exactly under the Ukrainian conditions, that will permit to realize the innovative potential and achieve a high level of its competitiveness and the desirable economic growth.

To determine the impact of intellectualization on the competitiveness of the economy we initially have analyzed the relationship between spheres involved in the intellectualization and the sphere of production and service provision.

2. Process of inteliectualization

All major areas that contribute to the development process of intellectualization, cooperate closely with the sphere of production and services. Herewith, they significantly affect its competitiveness. Accordingly new technologies developed in scientific sphere, cause and are one of the key factors determining the competitiveness of firms, as well as the

prepared by field of education staff. Similarly, information technologies are important for the spheres of production and services. It should be noted: the more productive new technologies will be developed in the sphere of science and higher quality knowledge gained by employees in the field of education, the higher the potential competitiveness of entities that produce and provide services in the economy will be.

The most known in the world and an adequate approach to study the principles of the economy international competitiveness is a model of M. Porter (Porter M.E., 2008). The essence of the rhomb rule derived by him is that the core competitiveness is the balanced development of its four determinants: a sustainable strategy and structure of firms, situation with the market demand, related and supporting industries and the conditions for the development of production factors. A specific role is given to the level of specialization of the employees and the innovation processes. He considers that the necessary conditions of this are scientific researches and constant learning, which is a task in higher education (education of high learning) and scientific spheres.

For a more thorough assessment of intellectualization we evaluated the higher education and scientific sphere relationships at key groups of factors that determine the competitiveness of the industry as a model of Porter (Porter's rhomb).

1. Concerning the impact of the main areas of intellectualization on the strategy of firms:
   - The scope of higher education provides staff training, managers of firms adequately build the company strategy;
   - The science creates new knowledge about management and strategy development;
   - Due to new technologies company executives can more effectively create and monitor the implementation of the strategy.
2. Regarding to their effects on the factors of production (here materials, technologies and employees are referred):
   - Due to the role of education increase employees can raise their level of specialization - which is a competitive advantage according to the theory of M.Porter;
   - New technologies developed in the field of science, allow raw materials to be more efficiently used, which also increases productivity, accelerates the production process, making it more efficient and productive.
3. Intellectualization also influences the cooperation of companies with supporting industries. Except described above positive effects on supporting industries personal activities, it:
   - - Through the field of education allows company employees to gain knowledge about the functioning of related and supporting industries, which increases the efficiency of cooperation;
   - New technologies often cause a multiplier effect, namely their use in supporting industries permits to raise labor productivity in major firms. Besides, they permit to improve the efficiency of cooperation among industries, reducing delivery time and products shelf life prolongation, etc.;

- The use of new information technologies allows to improve and accelerate communication between firms and industries to carry out joint projects and manage them.

4. Intellectualization also has an impact on conditions of local demand:
   - Training and informing consumers about services allow them to get more benefit from the market goods and services offered. It also makes them more demanding, which, according to M. Porter, improves the competitiveness of local producers and consumers of services;
   - The creation of new technologies and knowledge allows buyers to better understand the nature and quality of goods and services that they are offered;
   - Modern technologies allow consumers without leaving home from their computer to obtain information about prices and quality of products in the market, which significantly affects the demand.

In conclusion, fields of intellectualization play an important role in the development of all without exception factors that provide competitiveness of claster field from the model of M. Porter.

3. The way to increase of competitiveness

The main way to increase the level of competitiveness and effectiveness of the economy in Ukraine should be considered in the proclaimed back in 1998 by president of Ukraine National Academy of Sciences Borys Paton, "The course of innovative development of Ukraine's economy." It is generally treated as a "... shift emphasis to the use of innovative advanced technologies, the transition to the production of high - tech products, progressive organizational and management decisions in innovation regarding both micro- and macro-economic processes of development - creation of technology parks, technopolises, holding the policy of resource conservation, intellectualization of all production activities, 'softyzation' and 'servization' of economy".

The key measures for the implementation of this course are: creation of technology parks and technopolises, promotion the development of venture business, change in tax priorities policy, development of bank lending innovative projects, introduction of the national idea.

Herewith, their implementation should be carried and consider:
- Development trends in the modern world as an economic system and society as a whole;
- The complexity in approaches to solving this problem;
- Setting priorities adequate to the current situation, concerning the stages of its implementation and the corresponding sequence of economic measures use.

Ukrainian scientists wrote many works about improving the competitiveness of the economy. But implementation of this course remains a problematic issue. The reasons are, in our opinion, two.

1. Neglecting the leading ideas by governing bodies of the country, which are offered by domestic scientists. It is caused by two different factors: low prestige of science in the country and subjectively - mercantile oriented activity part of the officers vested with public authority.

- The lack of consistency in the research of scientists. In the writings the need for innovation is confirmed, the creation of innovative infrastructure, technology parks, venture capital funds and so on. However, it doesn't emphasizes the fact that:
- For the creation of appropriate the modern market needs innovations the modern base of knowledge is required. Innovations are not created from scratch, we need a continuous process of scientific researches, contacts with foreign researchers who conduct a similar activity;
- To ensure the efficient operation of technology parks requires a strong scientific base is required, which is formed by the experts from scientific researches in the relevant destinations. A steady stream of young researchers is required, appropriately trained and motivated to work;
- To attract new personnel to the process of scientific researches implementation not only the appropriate material stimulation is required, but also prestige of scientific research increase;
- In addition, the structural changes in the economy, the creation of adequate financial support are necessary, etc.

Therefore, there should be phasing offered, at first, you need to create the conditions for the creation of a basis - the productive work of economy intellectualization, and then provide innovativeness of economic activities.

4. Conclusions

All this requires the use of advanced development policy application in Ukraine. Namely, it is not advisable to go through all those stages which were covered by more developed countries. It is necessary to produce a path that will allow for a relatively short period of time to obtain a competitive advantage in world markets for domestic producers. The basis of this path should become orientation to future trends of international markets development, and the development of science and higher education should be the direction for it. It is expedient to quote the classic of world management of P. Drucker (Drucker P, 1999): "In today's world of competition, in order to remain in place you should run, and in order to move forward, you should run twice as fast."

The problem solving complex of the realization of economic development innovative course should be manifested through the development and application of appropriate organizational and economic mechanism. It should consider the priority of intellectualization economy process development. There does not exist a clear definition of this course implementation stages, therefore there is author's version proposed.

I stage: establishing a system of legal and investment instruments to enhance the process of the economy and society intellectualization (which also require certain institutional changes).

II stage: creating the conditions for interaction forming between the centers of knowledge creation and centers of their implementation.

III stage: investment maintenance system improve, the system of transformation the knowledge into innovative products.

IV stage: creating the conditions for the realization of innovative products in the Ukrainian and foreign markets.

Such approach to the selection of stages is based on the so-called "technology corridor", i.e. the way of realization of innovative products, "research - development - implementation." Applying it, we can deduce the relationship between intellectualization and efficiency of the economies: the creation of new knowledge - their implementation in production - realization on the market of innovations - manufacturer financial rents (profits) increase - economic benefits in society increase, the growth of wages - increasing the level of economic efficiency - increasing the resources to create new knowledge. If we are talking not about applied specialized, but about the theoretical specialized knowledge, its transformation will be very similar, but instead of industrial enterprise that implements it, there will be a higher education institution.

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BRIDGING THE GAP BETWEEN ACADEMIA AND BUSINESS: CURRENT TRENDS IN INFORMATION SYSTEMS ACTION RESEARCH

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ABSTRACT:
One of the attributes of competitive economy is a successful cooperation of academia with business. This relationship is however difficult to establish and maintain as the parties involved represent different objectives. The academia is concerned with theory forming and keeping the scientific rigor of the implemented projects while the business is interested in obtaining tangible results. One of the solutions to bridge this gap is the concept of action research. The paper will discuss how this concept has evolved, briefly asses the status of action research in information systems domain through literature analysis and present the basic principles of canonical action research.

KEYWORDS:
Action research, scientific rigor, relevance to practice, information systems

1. Introduction

Information systems (IS) discipline is a relatively young (i.e. approx. 50 years' old) area of applied science. Diversity has been its inevitable characteristic from the beginning. The diverse nature of IS domain may be considered at three distinctive dimensions (Benbasat and Weber, 1996): diversity in the problems addressed, diversity in the theoretical foundations guiding the research and diversity in the methods used for collecting, analyzing and interpreting data. The diversity of IS domain has been often the reason for a critique from many scientific communities. Some scholars perceive IS as the domain does not have a theoretic impact and thus lacking the scientific legitimacy. Others, admitting IS overexposed focus on practical issues, blame IS publications on methodological ignorance and therefore negate the significance of research results.

The native IS community perceives the described diversity in various ways – some as having the potential to tackle wide area of problems, but some as the necessity to increase the efforts to strengthen the weak domain identity. These issues are the matter of ongoing discussion within IS community which is called by some IS scholars the 'anxiety discourse'. Although this discourse is many-sided, it is limited to two main issues (Larsen and Levine, 2006). The first is concerned with juxtaposing the theoretical coherence vs. interdisciplinarity, while perceiving the IS domain, and the second, contrasting methodological rigor of the conducted research with practical usefulness of offered solutions.

The presented paper is focused on the second aspect of the anxiety discourse and is organized in the following way. The first section briefly describes the origins and applicability of action research (AR) in IS field. The second, presents a literature overview of the action research applied in IS domain taking into account the types of AR and the areas of their application. It also points out the papers that may be used as guidelines for scientifically rigorous and practically valuable research projects. The third section contains essential methodological steps of the most scientifically strict form of action research i.e. canonical action research. The key points of the paper are submitted in the conclusions.

2. Origins of action research and its applicability in IS

IS is an example of applied science discipline, i.e. its purpose is to resolve practical problems with the support of theory. The theory plays there a peripheral role whereas praxis is central. In any applied science discipline in general and in IS in particular, the undertaken research needs to be a win-win game in which, both the academia and praxis (i.e. business), are contributing. Such a relationship is not an easy one because both parties have different objectives. The academia is interested in long-term theory-building, whereas the business usually looks for obtaining quick, practical and financially justified solutions. This problem is even more complicated since on the one hand, undertaking a research from academic perspective implies the need for maintaining the scientific rigor, which paradoxically does not guarantee providing practical outcomes regarded as beneficial for the business, and on the other, focusing on practical problem solving may produce no valuable theoretical results. Thus, a compromise is needed. It is necessary to conduct a research in a way that will satisfy both parties. One of the possible solutions is action research (AR) – a type of applied research aimed at developing a solution to a real-life problem. It combines academia and practice and thus produces relevant research findings in the areas where no recognized theoretical models exist. In this sense AR is suitable to analyze new phenomena in complex social settings and therefore very promising for IS domain research types.

The idea of AR was introduced independently by K. Lewin (1951) at Research Centre for Group Dynamics at University of Michigan, who used AR in order to study social psychology in context of field theory, and by a group of researchers working at the Tavistock Clinic (Trist, 1976) who, when studying psychological and social disorders among veterans of war and prisoners of war camps, developed an operational research version of AR. Later when K. Lewin joined Tavistock Clinic these two distinctive methods have formed a more coherent perspective.

AR is a generic name that refers to a class of idiographic research approaches1 expressing the following common characteristics (Baskerville and Wood-Harper, 1996; Baskerville, 1999):

1. Research is aimed at getting a better understanding of an emerging social phenomenon, which is complex and multivariate in its nature;
2. Research targets both: practical problem solving and getting scientific knowledge, hence it is equally beneficial to the researcher and the organization;
3. The research process involves two elements: interpretive assumptions made about observation and interventionist character of the action performed by a researcher;
4. Research is performed collaboratively by a number of different actors, who in the end express their participatory observation;
5. The research process is cyclical and links theory and practice;
6. The acquired knowledge can be immediately applied;

Despite of the fact that AR has its origins in social science it does not belong to the mainstream research methods in this domain. However, it proved to be a popular and successful research approach in information systems discipline, especially when considering

1 According to German philosopher, Wilhelm Windelband, idiographic research is concerned with analysis, description of the concrete individual facts, whereas nomotetic is aimed at discovering and formulating the scientific laws.

European research tradition. Today, together with case study approach, AR belongs to the mainstream research approaches in the interpretive methodological paradigm2 in IS field (Cole and Avison, 2007).

3. Examples of AR research in IS field

There is a variety of AR approaches presented in IS literature. In one of the most frequently cited tutorial on AR, R. L. Baskerville (1999) distinguishes 10 types of action research used in IS domain: canonical, IS prototyping, Soft Systems Methodology, ETHICS, Multiview, action science, participant observation, action learning, clinical field work and process consultation. He also specifies four characteristics of a research process: (1) process model: iterative, reflective and linear, (2) structure: rigorous and fluid, (3) typical involvement: collaborative, facilitative and expert and (4) primary goals: organizational development, system design, scientific knowledge and training.

The subject of the analysis submitted in this section are the papers published in the two top-ranking academic IS journals that may be considered as advocating3 for action research: one American, i.e. MIS Quarterly, and one European, i.e. Information Systems Journal published in the years 1977-2012. The paper was considered as AR-related when it referred to this fact in its title, abstract or keyword section. The number of articles that fulfilled this criteria accounted for 29.

AR projects described in the related articles were used to solve a high variety of problems. They, however may be categorized into four groups: (1) system implementation or improvement, (2) methodology introduction, validation or improvement, (3) organizational analysis and (4) security/risk management (4).

The articles that belong to the first group include research projects aimed at system improvement of inter-organizational system (Alen et al, 2000), development of groupware support (Kock and McQueen, 1998; Davison and Vogel, 2000), development of internet retail store (Vrechopolulos et al., 2003) and implementation of physicians' profiling system to monitor and benchmark physicians' clinical practices and outcome (Kohli et al. 2004).

Other papers concentrate on the methodological aspects of the projects deployed. The articles that fit in this group either introduce a new framework that enable client-lead software implementation (Champion et al. 2005), apply a new methodology for strategy development

2 Referring to the typology of research approaches in IS domain proposed by Orlikowski and Baroudi (1991), i.e. positivist, interpretive and critical, AR can be assigned to the second group. In the interpretive approach the research process looks for scientific explanations of the causes of human actions. It is done through the analysis of the coherence of the discourse, its subjective interpretation and its correspondence with common-sense understanding of given phenomenon by the actors. The primary research object is the language that the actors use. Interpretative approach applies hermeneutics, phenomenology, ethnography, case studies and the observations of the actors in their natural environment. The social reality emerges in subjective manner, it is however being made inter-subjective through human interactions. All activities have a predefined meaning and are purposeful. The theory is purposed to help in the rational choice of the goals of the actions and the ways in which social order emerges.

3 Some scientific magazines within IS discipline, as in the other disciplines, do advocate for a certain type of the research to be published. This phenomenon is called a publication bias. Limiting the research sample to only two magazines was determined by the two factors: the type of the research to be described (i.e. AR) and the limited size of this paper.

(Tang et al. 2004), design principles for competence management system (Lindgren et al, 2004), or validate a new methodology in the organizational context (Grant and Ngwenyama, 2003; Oates and Fitzgerald, 2007). The methodological aspects of the projects deployed are presented also by Vidgen (2002). This paper, however, differs from the remaining articles in this group, as it extends the AR framework specified by Baskerville (1999), i.e. Multiview.

AR was also used in order to analyze various organizational factors related to information systems. Kohler et al. (2011) used AR to study the user experience in order to identify design principles while Street and Meister (2004) investigated how small business organization has developed IS enabled solution to address the organizational growth needs. Other studies in this category and used AR in order to investigate systems success and failures (Kaiser and Bostrom, 1982) or analyzing general and IS related organizational processes (Martensson and Lee, 2004).

The last group of the papers which employ AR in their research methodological layer are papers on system security or risk management. They treat on system security in general (Straub and Welke, 1998) and in particular: R. L. Baskerville and J. Stage (1996) have used AR to validate system risk analysis approach in prototyping situation, Inversen (2004) analyzed the risks connected with software improvement while Smith et al., (2010) valuated the system compliance with de jure security standard and Puhakinen and Siponen (2010) dealt with trainings aimed at increasing the employee security compliance.

Analyzing the articles from a scientific rigor perspective it may be inferred that there is no commonly accepted AR research framework. Some papers just refer to that fact by giving a simple introduction to AR but neither give an specific name to this approach nor describe in detail the framework they use (Kaiser and Bostrom, 1982; Kock and McQueen, 1998; Straub and Welke, 1988). Some other papers just give some generic characteristics of AR used in the research and/or put more attention to the description of the research design (Baskerville and Stage, 1996; Alen et al., 2000; Davison and Vogel, 2000; Vrechopolulos et al., 2003; Kohli et al., 2004; Tang et al., 2004; Puhakinen and Siponen, 2010). It is therefore difficult to find the research belonging to each and every category of the presented earlier typology of AR approaches and characteristics of a research process (Baskerville, 1999). The interesting group of papers constitute the articles referring to the AR characterized as iterative, rigorous and collaborative (three first characteristics of research process) or which have used the equivalent terms. These are the articles published by Grant and Ngwenyama (2003), (Iversen et al., 2004) and Oates and Fitzgerald (2007). This category may also be supplemented by a proposition of a new model of AR i.e. dialogical AR (Martensson and Lee, 2004). The papers that may be concerned as the most methodologically advanced are those that refer to the recognized AR categories, i.e. Soft System Methodology (Champion et al., 2005), Multiview (Vidgen, 2002) or canonical and/or explicitly indicating the process characteristics i.e. iterative, rigorous and collaborative (Lindgren et al, 2004; Smith et al. 2010; Street and Meister, 2004; Kohler, et al. 2011). They may be considered as the best examples of rigorous AR.

Within the research sample there were also 9 papers that did not present any AR-related research project but were concerned with the discussion and improvement of AR methodology (Darke et al., 1998; Braa et al., 2004; Davison et al. 2004; Mumford, 2006; Chiasson and Germonprez, 2009; Davison et al., 2012; Mathiassen et al. 2012) or comparing it with the other methodologies and paradigms (Siau, and Rossi, 2011; Lee and Hubona, 2009).

It is interesting to analyze the publications from the perspective of time. Considering the publications containing AR research projects (20 papers within the data sample) it may be

observed that the number of action research studies is growing. There is a significant increase of publications after the year 2000: there is only 1 article published in 80., 3 in 90. and 16 in the years 2000-2012. The recent publications are also more rigorous which testifies on growing awareness of the scientific merits. When looking at AR methodological papers (9 articles within the data sample) almost all (with the exception of only 1 paper) were published in the current century. This shows that IS community is interested in moving forward and perfecting AR methodology.

4. Canonical action research

Despite of the relative popularity of AR in IS domain this approach has been criticized by some scholars as lacking the scientific rigor and lacking the distinction from the consulting (Davison et al. 2004). It is therefore very important to design the research process in a proper way, in order to overcome the indicated shortcomings.

The distinction from the consulting can be assured by clarifying the research objectives (Baskerville, 1999): (1) communicating the scientific motivation aimed at practical problem solving, (2) articulating the commitment targeted at research community rather than at client needs alone, (3) conveying unbiased collaboration, (4) expressing theoretically justifiable recommendations and (5) obtaining the organizational understanding through introduction of iterative learning process rather than in one-step analysis.

The scientific rigor can be guaranteed through the use of the most advanced type of action research i.e. canonical action research (CAR). It may be distinguished from the other types of recognized AR research i.e. Soft System Methodology or Multiview, which serve mainly as approaches aimed at system development, as being more generic and flexible to suite a specific research objectives.

The structure and process for CAR was proposed in the field of organizational sciences by Susman and Evered (1978) and is being popularized and extended on the IS field by Davison et al. (2004, 2012). This approach is characterized as rigorous, collaborative and iterative research process and consists of the following five steps:

1. Diagnosis. The researcher and the practitioner (who jointly participate also in the all subsequent phases of the CAR cycle) identify or define relevant problems and their causes within the organization. They formulate and agree on the working hypotheses and the research phenomenon that is the subject of study in the subsequent steps of the CAR cycle.
2. Action planning. All necessary alternative actions that might lead to the problem solution are specified.
3. Action taking. The course of intended actions define the details of the intervention, which result in making relevant implementations.
4. Evaluating. The assessment of the actions taken as defined in the previous step.
5. Learning. Reporting on the results of the CAR cycle. Acquired learning should contribute to both the theory and the practice. Depending on the advancement of AR study, it may constitute the final results or the starting point to the next CAR cycle.

The research process is rigorous when all research steps are properly designed and executed according to the predetermined scheme within the research cycle. Rigor of the research refers to both, the methodological and theory building dimensions of the study. It is collaborative when there is a high degree of cooperation between academia and organization

during the research, aimed at the elaboration of the shared outcomes which satisfy both parties. In order to fulfill the requirement of the process being iterative, the research cycle (all 5 steps) needs to be executed at least two times during the study. Davison et al. (2004) advocate for strengthening the rigor and relevance of AR in the IS domain. They propose to extend the "classical" CAR by the following principles:

1. The principle of the researcher-client agreement which is purposed to establish a solid basis for a CAR study for all stakeholders. It facilitates assuring the rigor and the relevance of the study and helps to establish specific research objectives, data gathering methods and evaluation metrics for the whole project.
2. The principle of the cyclical process model imposes the sequential project execution in a systematic manner. Running several numbers of cycles helps to better understand the context of the organizational problem and apply relevant theories.
3. The principle of theory4 considers a variety of theoretical perspectives used in the diagnosis and learning stages. The theory is used to frame the analyzed problem and to conduct the intervention.
4. The principle of change through action contributes to rigor and relevance by ensuring that planned actions follow from the hypothesized causes and they are intended to improve the organizational situation. Proposed changes need to be grounded in the rigor of theory and be relevant to the organizational reality.
5. Principle of learning through reflection ensures that both parties explore what they have learned. Researchers focus on theories (how they need to be modified) while practitioners focus on how the proposed theory-based solutions are relevant to the similar problems in the future.

Each principle is described by detailed criteria (approx. 6 per principle) which constitute specific guidelines allowing to carefully form the motivations to the research and design the research process itself.

5. Conclusions

Although AR is a marginal research method in social sciences it became relatively popular in the IS domain. There are several reasons for this situation. First, it is the nature of IS phenomenon, which is complex, multivariate and diverse. Second, the function of IS as an applied science discipline is to solve practical problems. On top of these reasons is the third one: the need to simultaneous contribution to the scientific rigor and the practical relevance of the conducted discovery and acquired results.

Studying the character and trends related to AR in the IS publications it may be inferred that this approach is being used to solve various organizational problems and that the concept is advancing quantitatively and qualitatively. The number of publication has significantly increased over the four past decades. The published papers advance also in their quality. The publications from the current and the past decade are rigorous relevant and

4 The in-depth discussion concerning the role of the theory in CAR is presented by Davison et al. (2012). The authors performing a critical analysis of recent CAR methodology, indicate four challenges of CAR. These are: challenge of diagnosing the current situation, challenge of planning interventions and organizational changes, challenge of evaluating the impact of an intervention and challenge of the nature and role of theory in CAR. They admit that all challenges are theory-related and give the guidelines how to overcome them.

present a high quality academic research. The same degree of advancement in quantity and quality concerns two publication types: research projects illustrating the use of AR in the organizational settlements and the methodological papers discussing and advancing merits of the AR research.

The development of AR points at the use of canonical version of action research (CAR). This particular type of AR is rigorous, collaborative, iterative and flexible enough to be appropriate to solve a vast majority of complex organizational problems with the sufficient scientific rigor and relevance to practice. Using AR in general and CAR in particular will certainly help to bridge the gap between the academia and the business, as the main characteristic of this approach is to equally fulfill their distinctive research objectives.

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Proces Management and its Support

IT SUPPORT FOR SALES MANAGEMENT IN THE COMPANY OKD A. S. (JOINT STOCK COMPANY) AS A MEANS TO INCREASE COMPETITIVENESS

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ABSTRACT

The article describes the importance of IT support in managing sales and shipping of coal in OKD a.s. (producer of hard coal and coke in the Czech Republic) as an important tool for increasing competitiveness. Customer demands for compliance with the quality parameters of coal and coke are constantly rising and due to competition from suppliers from foreign countries (Poland, China...) there is also downward pressure on the prices. Without IT support in terms of information systems linking the entire chain of stores - planning - production – sales, it is no longer possible to succeed on the market. In the 90s, there were local sales management systems introduced in several of OKD's mines. Later, a comprehensive sales management system was implemented (in 2002-2005), which integrated and significantly simplified management activities. During the ten years of operation, the system has proved to be successful and, in addition to a comprehensive overview and more effective sales management, it has also brought significant savings. One of the problems that needs to be solved in the operation of such a complex system, is the tendency of some users to carry out part of their work using the so called "end-user computing". It may bring short-term effect, when the part of the users in the management process has the necessary information, but in the long-term and strategic perspective, it leads to storing information outside of the information system, which may consequently create problems. In the article, we outline the types and reasons of end-user computing and possible solutions in the field of IS (ERP), and also in the area of proper distribution of responsibilities and their observation in the organizational structure of the business department.

KEYWORDS:

Coal and coke quality parameters, sales control system, coal mining, end user computing

1. Introduction

Quality control in the production of black coal and coke is one of the main activities in coal mining and processing. Meeting quality parameters required by customers is crucial for the economic performance of coal and coke producers. The only producer of black coal in the Czech Republic is OKD, a. s. (joint stock company). Nowadays, the company operated five deep mines and four coal preparation plants (Darkov, ČSM, Karviná, Lazy) where raw coal is processed. With 12,000 employees and an annual production of 11 million tons of coal, it belongs among the largest employers and companies in the Czech Republic. All coal mining and coal processing facilities are situated in the Ostrava-Karviná region.

Extracted coal varies in its quality parameters and various categories of coal are available on the market. Nevertheless, black coal can be divided into two main categories - thermal coal and coking coal.

Thermal coal is of lower quality and is used to produce heat or in power plants to generate electricity. The quality of thermal coal depends on ash content, water content, calorific value, and sulphur content. The most important parameters are ash content and calorific value. For thermal coal, the values of these parameters must fall within a specific range. If ash content (the content of non-combustible components) is too high, calorific value is lower. If on the other hand ash content is low, calorific value may be too high which may damage boilers.

Coking coal has significantly higher quality. It is the feedstock for the production of coke. From the economic point of view, coke constitutes a much better product because it is sold at a much higher price and brings significantly higher profit. The aim of a mining company therefore is to produce the maximum amount of coking coal of the highest quality. In addition to ash content, moisture content, sulphur content, and calorific value, the quality parameters for assessing the quality of coking coal include also coking parameters such as swelling index and dilation [3].

Coke is produced by the pyrolysis of hard coal at high temperature (above 1000 °C) in the absence of air. Due to its high calorific value, coke is used in metallurgy and foundry industry. In the Czech Republic coke is produced by company OKK-Koksovny a.s., which is a subsidiary of OKD. OKK is currently the largest producer of foundry coke in Europe [1]. Coke produced by OKK-Koksovny can be divided into three categories: metallurgical coke (blast furnace and foundry), heating coke (nut 1 and 2) and technological (peas and dust). In terms of business economics, the most important is the production of foundry coke. It's used in facilities for the production of cast iron and for the production of basalt-based insulation materials. Closely watched quality parameters of foundry coke are: water content and contents of ash, sulfur, phosphorus and volatile substances. Other important attributes of coke are: calorific value, compliance with grain size, contents of undersized coke and mechanical properties of coke such as strength (micum) M40 and abradability M10. Concerning the blast furnace coke, coke reactivity index CRI and coke strength after reaction index CSR are important as well.

Quality control and management of produced coal and coke is absolutely vital for the fuel sales on the market, and therefore for the economic results of OKD.

2. Monitoring and control of quality parameters

In the past, the methods used for controlling the quality parameters of coal were rather limited. Exploration drilling was carried out in individual coalfaces. The qualitative parameters of extracted coal were estimated and a mining plan was drafted for the period of one year. It allowed creating a rough plan of extraction which could be harmonized with the customers' requirements so that contracts for the supply of coal could be concluded. In addition, it is possible to control the quality of coal to a certain level during the process of coal preparation. This type of quality control is carried out in the laboratories of the Department of Quality Control (DQC). Here, coal samples are analyzed with relatively high accuracy, but the analysis is time-consuming and it concerns only the final products of the preparation process. Quality control during production was therefore possible only on the basis of estimations and experience.

More sophisticated control of quality parameters was possible only with the advent of computer technology, and particularly after the introduction of the on-line measurement of quality parameters, especially the continuous on-line radionuclide ashmeters and hygrometers produced by Enelex, Berthold or Wilpo [4]. In the mid 1990s, all the coal preparation plants were equipped with continuous sensors and automatic regulation of plant technology units

(flotation, heavy liquid treatment, jigging, sortation, and dewatering). Between 1997 and 2002, the coal preparation plants were also equipped with information and control systems [2].

Automation and automatic control allowed establishing technological units in the preparation plants for coal homogenization which are used primarily in the production of thermal coal. The main objective of homogenization is to stabilize ash content in thermal coal. If the ash content of produced coal exceeds the desired limit, higher quality coal is added in the required ratio. On the other hand, if ash content decreases significantly, the waste products of other preparation processes are added to the raw material. This leads to the artificial degradation of produced thermal coal while reaching the desired quality and utilizing the otherwise unsalable waste material produced during coal preparation, for example the intermediate product of jigging. Automatically controlled processes also allow the utilization of coal slurry stored in lagoons near coal mines. In the past, slurry was the waste product of coal preparation and presented a considerable environmental burden for the landscape. At present, slurry is excavated from the lagoons by suction dredgers and added to the homogenization line.

All OKD coal preparation plants are now equipped with an information system which allows on-line control of the most important quality parameters through the use of information obtained from continuous ashmeters and hygrometers. Based on these data, the software of the information systems calculates trailing average and analyzes trend. In this way, a timely notification can be issued for the loading line operators informing them that the values of quality parameters may get out of the required ranges which would result in a failure to meet the loading parameters of a specific order or purchase agreement. The operators are thus able to perform control actions already in the course of the technological process of preparation, e.g. to use raw material from different silos or different treatment technologies, or to use one of the homogenization technologies. In the past, when managers and technologists at the preparation plants did not have any information systems, exceeding quality parameters was often discovered only after loading when coal was already in wagons.

The deployment of information systems, sensors, and automation tools allowed plant managers to control the quality of coal during technological processes. It has resulted in significant economic effects on the production of coal:

- There has been a reduction in the number of operating staff.
- Timely information about significant deviations from the required quality parameters has allowed for corrective action in the course of coal preparation.
- The quality of production has stabilized significantly.
- Work efficiency has increased (as a result of the on-line control of staff performance with the possibility to review the course of production).

On the other hand, the operation of coal preparation plants has become dependent on the functioning of the information system. Without the system, it is no longer possible to ensure the required quality of coal production within a given range. [3]

In 2002, a comprehensive information system called “Odbyt BOS“ was deployed (authors Danel and Skotnica; the name of the system consists of the Czech word for sales and the name of the company for which it was originally developed) at BOS, the predecessor of the present-day OKD Business Department which is responsible for all business activities of OKD. The system Odbyt BOS integrates information about loading and dispatch of railway wagons from all OKD preparation plants with the information system of the carrier OKD

Doprava, a. s. (AWT since 2010) and with the ERP information system of OKD (SAP R/3) which is subsequently used for invoicing and balance processing.

At present, the sale of coal and coke in OKD is still managed with the information system "Odbyt BOS". The original plan for further development of the system, which was formulated in 2001, was influenced by structural and ownership changes in OKD, particularly by the change of OKD structure in 2005 and the change of OKD owner in 2008. The private owner, New World Resources, puts emphasis on the operation of the company to maximize profit which also leads to the optimization of business and management processes. Today, these processes cannot be performed without high-quality information support any longer. In the late 1990s, ATP Soukup s .r. o. (Ltd.) developed separate information systems for DQC laboratories which allow recording and evaluation of performed analyses and printing fuel quality reports which are mandatory documents required by both customers and coal carriers. Information on the analyses including trend analyses and balance statistics are also available to production plant managers. [3]

The information system Odbyt BOS has been connected with the local information systems of the DQC laboratories at individual coal preparation plants, which allows centralized recording of coal quality parameters for all coal dispatched from OKD.

In 2005, central dispatch for expedition and sales of coke was created. Later it was integrated into the information system "Odbyt BOS". Initially, coke plant Jan Šverma (now already closed) and then coke plant Svoboda were integrated. Figure 1 shows us the main processes of fuel sales at given level of resolution.

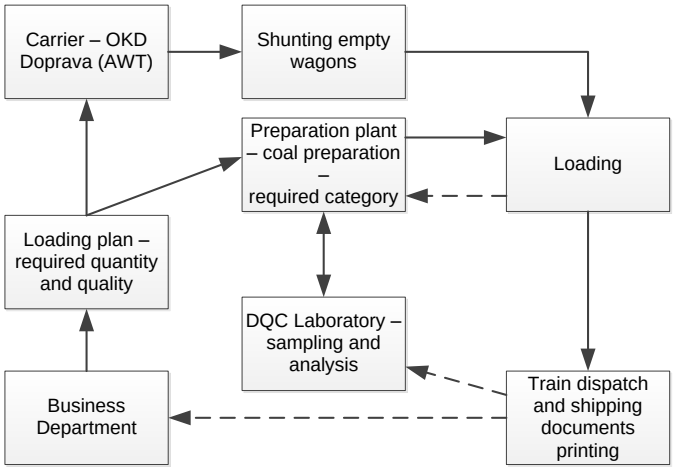


Figure 1 Scheme of coal dispatch subsystem

Currently, we're addressing tighter integration with information system of our transport contractor (formerly OKD Doprava, a.s., now AWT), where at the beginning of 2013 the information system ISDL by OLTIS company (replacing the outdated system „Železnička" by the Adamsoft company introduced in early 90's) was implemented. New information system, named DISC, used by ČD Cargo's dispatching centers is in the process of implementation since February 2013. We are also considering using the RFID technology for tracking wagons.

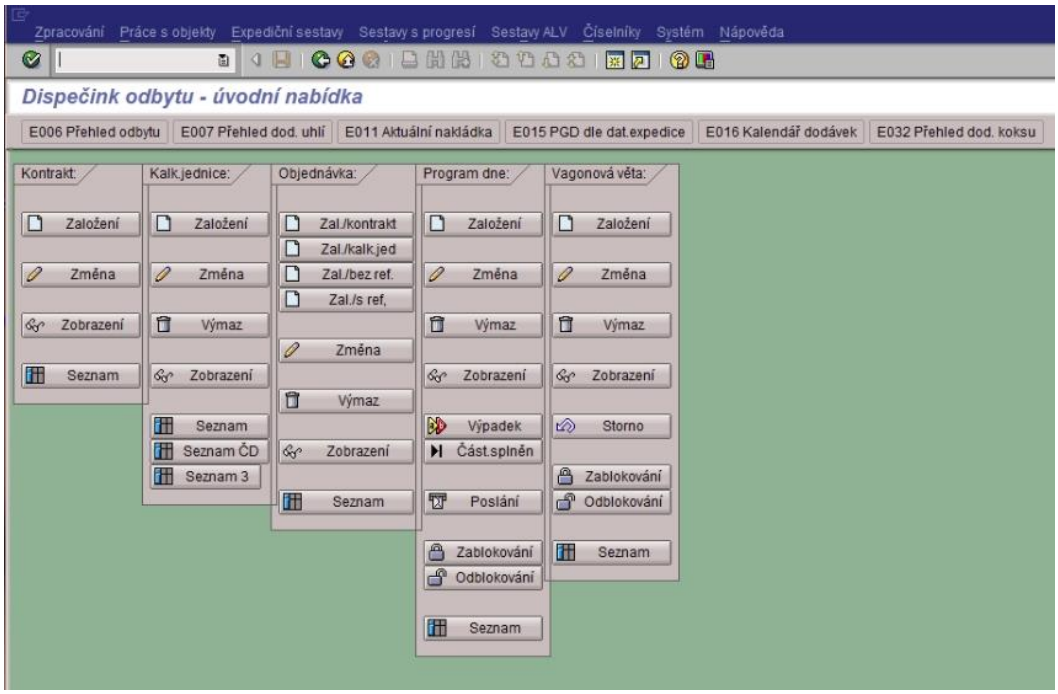
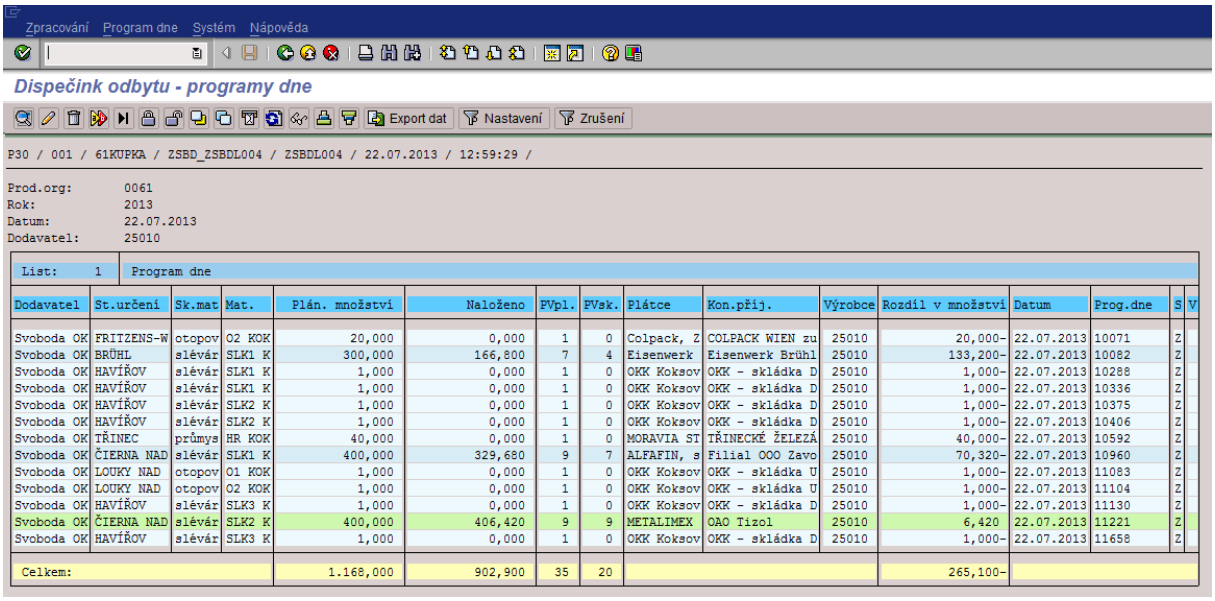


Figure 2 ERP SAP – main menu



Dodavatel	St.určení	Sk.mat	Mat.	Plán. množství	Naloženo	PVpl.	PVsk.	Plátce	Kon.přij.	Výrobce	Rozdíl v množství	Datum	Prog.dne	S	V
Svoboda OK	FRITZENS-W	otopov	O2 KOK	20,000	0,000	1	0	Colpack, Z	COLPACK WIEN zu	25010	20,000-	22.07.2013	10071	Z	
Svoboda OK	BRÜHL	slévár	SLK1 K	300,000	166,800	7	4	Eisenwerk	Eisenwerk Brühl	25010	133,200-	22.07.2013	10082	Z	
Svoboda OK	HAVÍŘOV	slévár	SLK1 K	1,000	0,000	1	0	OKK Koksov	OKK - skládka D	25010	1,000-	22.07.2013	10288	Z	
Svoboda OK	HAVÍŘOV	slévár	SLK1 K	1,000	0,000	1	0	OKK Koksov	OKK - skládka D	25010	1,000-	22.07.2013	10336	Z	
Svoboda OK	HAVÍŘOV	slévár	SLK2 K	1,000	0,000	1	0	OKK Koksov	OKK - skládka D	25010	1,000-	22.07.2013	10375	Z	
Svoboda OK	HAVÍŘOV	slévár	SLK2 K	1,000	0,000	1	0	OKK Koksov	OKK - skládka D	25010	1,000-	22.07.2013	10406	Z	
Svoboda OK	TŘINEC	průmys	HR KOK	40,000	0,000	1	0	MORAVIA ST	TŘINECKÉ ŽELEZÁ	25010	40,000-	22.07.2013	10592	Z	
Svoboda OK	ČIERNA NAD	slévár	SLK1 K	400,000	329,680	9	7	ALFAFIN, s	Filial OOO Zavo	25010	70,320-	22.07.2013	10960	Z	
Svoboda OK	LOUKY NAD	otopov	O1 KOK	1,000	0,000	1	0	OKK Koksov	OKK - skládka U	25010	1,000-	22.07.2013	11083	Z	
Svoboda OK	LOUKY NAD	otopov	O2 KOK	1,000	0,000	1	0	OKK Koksov	OKK - skládka U	25010	1,000-	22.07.2013	11104	Z	
Svoboda OK	HAVÍŘOV	slévár	SLK3 K	1,000	0,000	1	0	OKK Koksov	OKK - skládka D	25010	1,000-	22.07.2013	11130	Z	
Svoboda OK	ČIERNA NAD	slévár	SLK2 K	400,000	406,420	9	9	METALIMEX	OAO Tizol	25010	6,420	22.07.2013	11221	Z	
Svoboda OK	HAVÍŘOV	slévár	SLK3 K	1,000	0,000	1	0	OKK Koksov	OKK - skládka D	25010	1,000-	22.07.2013	11658	Z	
Celkem:				1.168,000	902,900	35	20				265,100-				

Figure 3 SAP – Daily Loading Programme

Employees of sales department, quality control, transport and billing do access the most important features of ERP of the SAP system via the main menu „Dispečink odbytu“ ("Sales central control"), as shown in Figure 2. In accordance with job title, users are given the appropriate authorization for accessing certain features from the main menu. The relevant transaction (program startup in ABAP language in the SAP system) can also be executed from a text field by typing the name (code) of the transaction. SAP's Program of the day interface (Figure 3) provides means to check the course of the planned loading and to make changes in the loading plan. One of the most important entities in the process of fuel sales is the wagon sentence containing one of the main attributes – the railway carriage number. Main characteristic for trucks (LKW) is RZ (Registration number of the vehicle, formerly Motor vehicle number plate (SPZ)). The SAP also allows users to create custom reports, which are mentioned below in the section on End User Computing.

3. End user computing

With the introduction of any ERP information system, it's expected that the activities of end-users will be carried out only within the IS and that end-users, as part of their job activities, will have very little use of Office applications (especially MS Excel) because outputs and information presented by office software will be replaced with the appropriate outputs from the IS. Yet it often doesn't happen. Let's take a closer look at reasons, why are these activities exercised outside of the IS, and try to determine their causes, respectively consider their necessity and consequences.

3.1 Categories of End user computing

3.1.1 Inertial (habitual) EUC

Many activities practiced outside of IS happen because of their long-standing inertia and historical background. Users create variety of reports and spreadsheet calculations simply because it's always been done this way, and for some customary reasons, users don't want to give them up and simply reject the fact that this kind of work isn't demanded from them and doesn't benefit anybody (including the users). In the worst case scenario, even the printed copy is created and filed into binder, thereby increasing the expenses on office supplies and space for storage. EUC of this type is highly undesirable.

3.1.2 EUC due to unfamiliarity with the IS

User creates reports outside of the IS. These reports are based on various reports generated from the IS and the information is then analyzed and sorted in MS Excel spreadsheet, while not knowing that such a report can be tailor made by choosing various attributes directly in the IS. A report can be saved under user's username in the SAP system. This includes report protection, and if necessary, there's an option to export the report to MS Excel.

The reason for EUC, in this case, rests in insufficient training of the users. If the user isn't downright "nosy type" and he doesn't get acquainted with the IS himself, he often cannot figure it on his own. Also, user documentation covers IS only on general level and doesn't cover all the aspects of IS in detail. Many users don't even know where to download the documentation.

3.1.3 EUC due to incorrect analysis during implementation of the IS

User doesn't have the option to create the desired output, because IS doesn't allow it, and so the user is forced to use different tool. In this case, the error resides with the analysis of user needs during the implementation of IS. Error might occur in the lack of communication between the user and the implementation team. User either didn't clearly formulated his demands or the analyst inappropriately or inadequately inquired about those demands, and therefore certain feature wasn't created. Particular gap can be corrected and the required feature can be added at any time, in accordance with the contractual terms between the provider of IT services (ERP administrator) and the Company.

3.1.4 Authorization and EUC

Specific case occurs when it's technically possible to extract the required information from the system, but the user isn't allowed to do that due to insufficient access rights to particular module of the IS. The employee doesn't have, under the authority of his job title (assignment), the authorization to access that part of the IS, but he needs to obtain the data.

Then the user resorts to collecting the data from the employees with different competencies and he creates various reports and outputs using office applications. This is mostly done at the behest of superior, respectively following superiors' requirement of a specific set of data. The solution is to extend the authorization for the user to access a particular module or segment of the IS (mostly "read only"). Thereby the user can access the data and he's allowed to create reports and export the data.

3.1.5 EUC and IS data request processing time

If it's necessary to obtain large amount of data from the IS, i.e. many attributes and records concerning a longer period of time (usually several years), then this request can take a very long time and the user has to wait for the requested output. For these reasons, the data and follow-up surveys are also conducted outside of the IS. The purpose is to get fast response to user's request. Data acquired by EUC are also accessible in times of scheduled maintenance or downtime of the IS.

3.1.6 Necessary EUC

This form of EUC covers areas that the current IS is not able to. In terms of OKD, it is e.g. scheduling of loading and sales of coke produced by OKK Koksovny. Given the specificities of technology for production and dispatch of coke, the "Systém odbytu paliv" ("Fuel sales system") cannot be fully applied, because it was created for the shipment of fuel from mining plants. For mining plants it's usual to expedite the product on same day it was produced. Coke plants are different, loading (production) takes place for several days and then the product is expedited. It means that there are two basic processes - production and shipping. Therefore an MS Excel application with the use of VBA was created. The application is capable of putting the production process (in relation to the subsequent dispatch) into algorithms and is also able to ensure additional subroutines associated with it, such as: ordering transport contractor's wagons, loading plan, dispatch sheets, etc. Transmission of the shipping data to the IS SAP is taken care of by „Systém odbytu paliv" („Fuel sales system").

Another necessary EUC is caused by data from external companies (transport contractors, shippers, etc.), that are not connected to the OKD information system. Example of such a company is ČD-Cargo from which we receive a notice on broken-down delayed wagons or ZAN (information on the prohibition of loading due to transport obstacles on the route).

3.2 EUC consequences

Given that the current ERP SAP/S3 OKD was implemented in 2002, there has been a long time, during which much has changed. Previously sufficient IS features were gradually revised according to the new requirements, but it is still just a modification of the existing system. The present time calls for more information to be contained in the IS (both on outputs and inputs).

In the area of fuel transportation, the intermodal transportation is taking over the conventional railway transportation. For example, customers now require specific supplies, with two containers placed on one rail chassis while each container contains a different kind of goods for two different end users. After reaching the designated railway station, goods is then transported by trucks. Current information system is not prepared for such an option and so every shipment demands manual IS intervention from an IT employee. Also, with the development of truck transportation (LKW) more loading sites (which have insufficient or

virtually none network infrastructure) appeared, and virtually no information is transmitted directly. Instead, information is transmitted by the means of faxes and mediated e-mails. Feature for the issue mentioned, as well as for printing CMR sheets (CRM is Convention on the Contract for the International Carriage of Goods by Road), is not implemented in the system and therefore it would be advisable to upgrade the system.

Also the administration of code list of customers, payers, transport contractors, etc., should be transferred from the IT department to a point, where the user himself can create new item according to established rules. There is also archaic terminology being used in the current system and it's incorrectly assumed by new employees.

This is just a small list of issues the current IS already can't cope with causing undesirable end-user computing necessity. For this reason, it's needed to re-analyze all the current processes in fuel distribution area, suggest new solutions and within that consider a complete redesign of the existing IS. However, given the current economic recession and large worldwide fuel prices decline, it is unlikely that release of funds for such an extensive modification will be done.

4. Conclusion

It's up to the discretion of each user to consider whether it's really necessary to use an application outside of the information system. Whether there isn't an alternative to achieve his goals directly in the IS. In most cases it really is, but we continue to fill our hard disc drive by files that fall into oblivion and which are essentially duplicate reports from the enterprise information system. Extreme case of EUC is creating additional printed copy and filing it into binder, thus increasing requirements for backup and archiving capacity. Also without EUC, the users would save a lot of time that they should devote to their major scope of employment.

The company should place greater emphasis on training users (including those in managerial positions) on working with the IS. More hours of user training is dedicated to office software than to the information system. Also, during the implementation, users should clearly specify their requirements in order to avoid necessity of implementing additional features and modifications by the time the system is already running. Also, it has been 11 years since the introduction of information system SAP in OKD (sales management system was introduced even earlier) and demands on the system change dynamically, so that what once was enough is no longer satisfactory today.

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BUSINESS PROCESS MODELING UTILIZING UML AND ORM PERSPECTIVES

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ABSTRACT

The paper addresses business process modeling with the focus on value modeling, utilizing UML and ORM (Object-Role Modeling) notation. REA (Resource Event Agent) value model, which represents business process model in value modeling framework, is traditionally presented by UML notation. ORM notation is in many ways more specific notation than UML notation with direct relation to ER diagrams. The core of the paper is to present both perspectives and illustrate their comparison and evaluation on a concrete example.

KEYWORDS:

Business process modeling, object-role modeling, REA ontology

1. Introduction

Business process modeling is currently the best way to understand an enterprise. The next step is to design an appropriate database structure for the specific information system that supports some activity from the concrete business process. The quality of a database application crucially depends on its design. To help ensure correctness, clarity, adaptability and productivity, information systems should be specified at the conceptual level first, using concepts and language that designers and customers can easily understand (Halphin 2001). The Unified Modeling Language (UML) was predominantly focused on object-oriented programming and can be used for database design as well assuming stripping of object-oriented implementation details. Specifically the class diagram provides an extended Entity-Relation (ER) notation that can be annotated with database constructs. UML's object-oriented approach facilitates the transition to object-oriented code. Object-Role Modeling (ORM) that represents a fact-oriented approach provides a better way to capture and validate data concepts and business rules with domain experts. ORM also focuses on structural changes in the application. By omitting the attribute concept, ORM allows to communicate in simple sentences. ORM diagrams (pictures) simply capture the world in terms of objects (entities or values) that play role (parts in relationships). ER notation as well as UML notation allows relationships to be modeled as attributes. ORM models the world in terms just of objects and roles, and hence has only one data structure – the relationship type. As a consequence, ORM diagrams take up more room than corresponding UML or ER diagrams.

The structure of the paper is as follows: In Section 2, REA value model representing a business process is described. Object-role modeling, its basic features and possibilities for utilization is presented in Section 3. Section 4 addresses the concrete example of ORM application on REA value model. Section 5 discusses achieved results and Section 6 concludes the paper.

2. REA Value Model – Business Process

The REA ontology belongs to value modeling business ontologies and links together business process modeling with underlying economic phenomena. The REA ontology benefits from the presence of a semantic and application independent data model, an object-oriented perspective, and abstraction from technical and implementation details. In addition to other aspects, it offers full traceability of all activities that influence the value of the enterprise's resources. That enables the possibility to calculate the value of the enterprise's resources on demand. Furthermore, the REA ontology contains rules for formulating well-formed models of enterprise processes (Dunn 2004). The goal of the economic agent's processes is to increase the value of its economic resources. All well-formed REA models obey a fundamental rule, that there is no increase of the resource value for free, that is, for an economic agent every increase of a resource value is always paired with some decrease of the value of some of its resources (Hunka 2011). This fundamental feature of every REA model is that it answers the question why an enterprise performs a given activity. In other words it explains why the economic events occur (Hruby 2006).

The REA value model represents a model of a business process and creates a principal view provided by the REA ontology. The operational level is created with three kinds of entities, an economic resource, an economic event and an economic agent. An Economic Resource is a thing of given value that is scarce, and has utility for economic agents. In business applications, economic resources are changed or converted for another economic resource. Examples of economic resources are products and services, money, raw materials, and labor. An Economic Agent is an individual or organization capable of having control over economic resources, and transferring or receiving the control to or from other individuals or organizations. Examples of economic agents are customers, employees, vendors, and enterprises. An Economic Event represents either an increment or a decrement in the value of economic resources that are under the control of the enterprise. Some economic events occur instantaneously, such as the sale of goods; some occur over time, such as rentals, labor acquisition, and the provision and use of services. Apart from entities, the REA value model declares relationships between both different entities and between entities of the same type. The most important of these relationships is the duality relationship that links decrement events with an increment event.

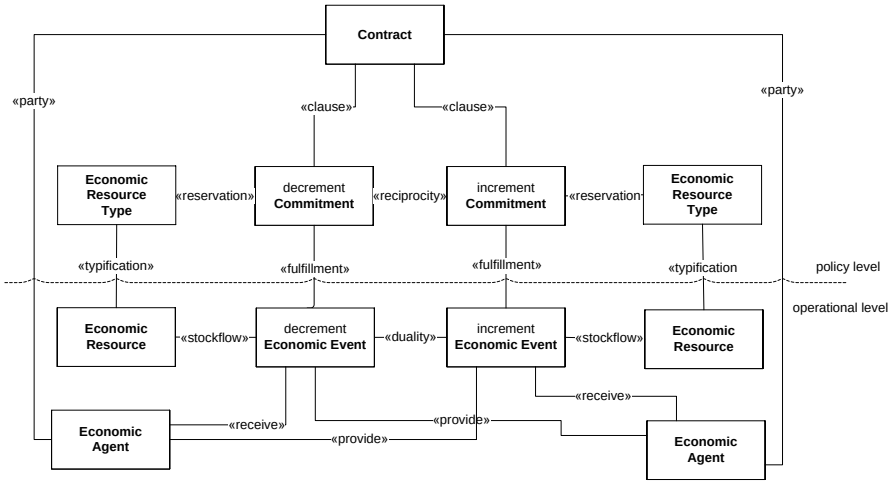

Fig. 1 REA exchange value model - business process

The policy level of the REA exchange model (Geerts, McCarthy 2006) is created with a *Contract*, *Commitment*, *Resource type*, and *Agent type*. The *Commitment* is a promise or obligation of economic agents to perform an economic event in the future. Examples of

commitments in exchange processes may be a promise or obligation to sell goods and receive payments. Each commitment is related to an economic event through a fulfillment relationship. Decrement commitments relate to increment commitments by the reciprocity relationship. A contract is a series of things or activities that should be done during a given time interval. In short, a contract is a collection of increment and decrement commitments. Fig. 1 illustrates general exchange process.

3. ORM in a detailed view

Object-Role Modeling is a conceptual modeling method that views the world as a set of objects that play roles (parts in relationships) (Halphin 2001). For example, you may play a role of walking in the country (a unary relationship involving just you) or you may play a role reading this paper (a binary relationship between you and the paper). Thus a role in ORM corresponds to an association-end in UML, except that ORM also allows unary relationships. The main structural difference between ORM and UML is that ORM excludes attributes as a base construct and treats them instead as a derived concept. Conceptual schema using ORM specifies the information structure of the application in the forms of: *fact types* that are of interest; *constraints* on these; and *derivation rules* for deriving some other facts.

A fact (or an instance of a fact) is a proposition that is taken to be true by the relevant business community. *A fact type* is a kind of fact that may be represented in the database (Dietz 2006). The *constraints* represent constraints or restrictions on populations of the fact types. The *derivation rules* include rules that may be used to derive new facts from other facts.

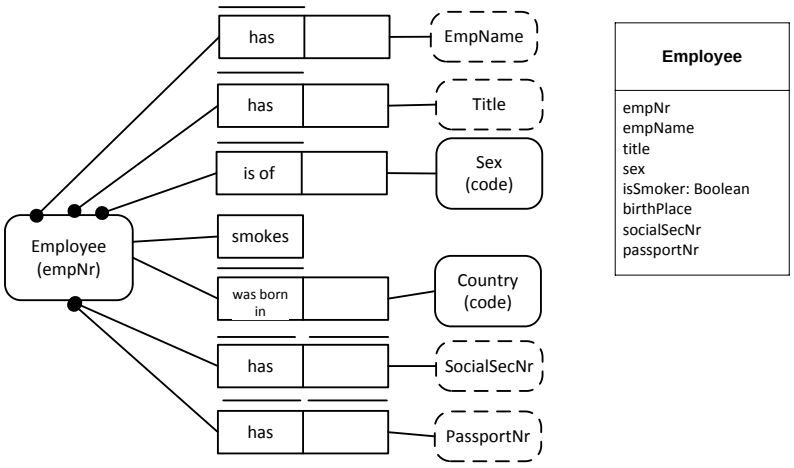

Fig 2 ORM relationship types and UML class description; source [own]

The ORM model (left part of Fig. 2) indicates that employees are identified by their employee numbers. The top three roles (EmpName, Title and Sex) are mandatory roles. This is indicated by the black dots at the *Employee* square. The other black dot where two roles are connected (at the bottom of Employee) is a disjunctive mandatory role constraint indicates that an employee must have a social security number or a passport number or both. The uniqueness of constraints (cardinalities in UML) indicates vertical lines over the roles. In Fig 2 it means that *empNr*, *EmpName*, *Sex*, and *Country* is unique for each employee. Two vertical lines over each roles (SocialSecNr, PassportNr) indicating that each *employee number*, *social security number* and *passport number* refers to the one employee at most. The dashed line over e.g. *PassportNr* indicates that this is a value not an object.

4. Concrete example

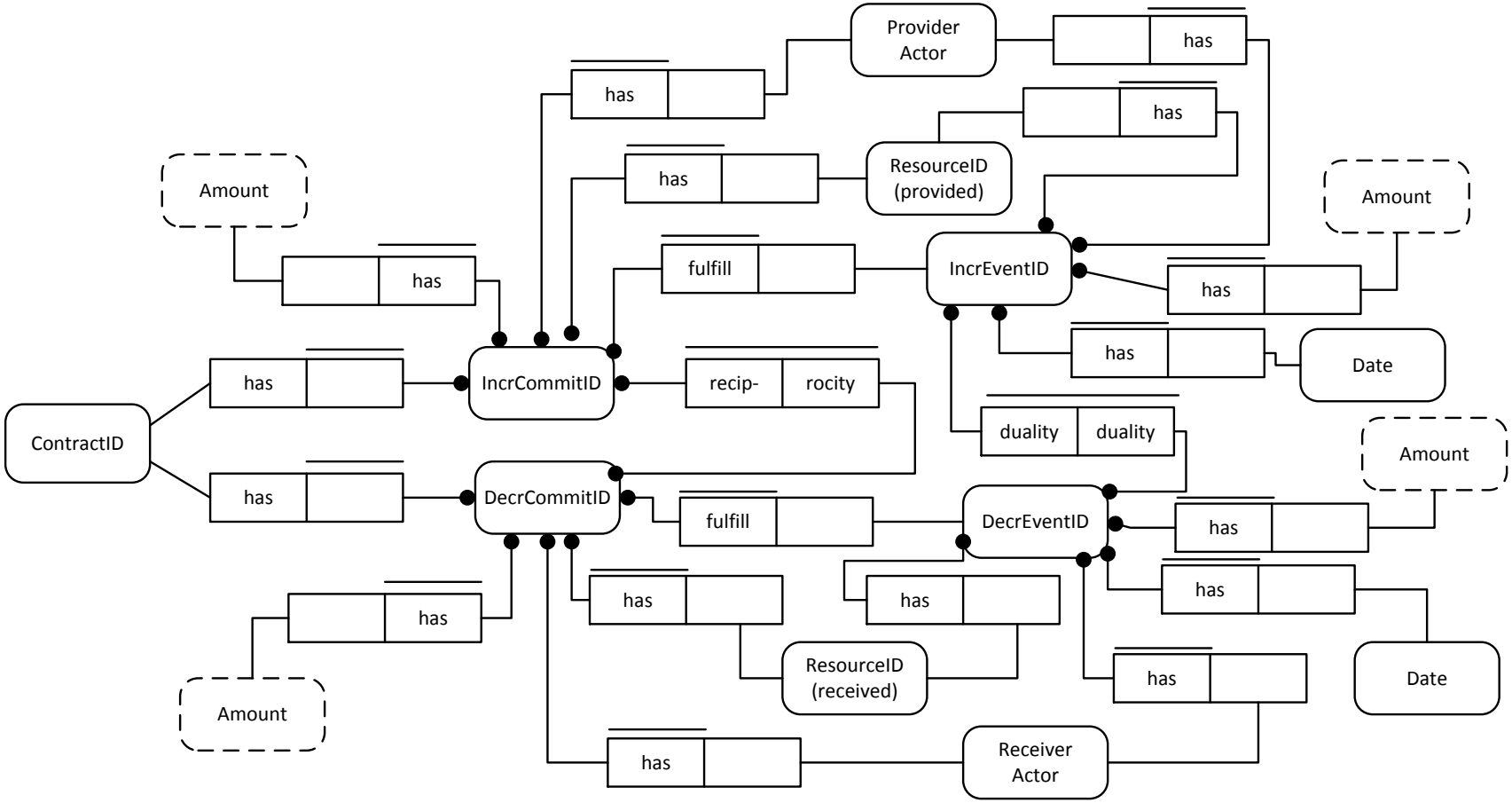

Fig. 3 ORM diagram of the REA exchange value model

This chapter describes and illustrates ORM diagram of the REA value exchange model, see Fig. 3. As a basis for this diagram the REA value exchange model was utilized, see Fig. 1. From the first sight it is obvious that the ORM diagram is more room consuming than the REA value model depicted utilizing UML notation. This is brought about by the fact that in ORM, all data attributes are expressed in the form of their roles. Contract represented by the *ContractID* is composed of increment and decrement commitments. Increment and decrement commitments are related by exchange reciprocity relationship with *m:n* cardinality. This cardinality is indicated by the vertical line over both roles. Each commitment is related to the value of the Amount. Apart from, each commitment is related to the corresponding *Actor*, *Resource* and *Event*. All relationships are expressed in the form of roles, particularly binary relationships. Increment and decrement events are related by exchange duality relationship with m:n cardinality. The purpose of the exchange duality relationship is to keep track of which resources were exchanged for which others. The fulfillment relationship relates corresponding commitments to corresponding events. Each event is related to the corresponding resources and actor. Contrary to commitment, an event records real value achieved during exchange process. The real values are represented by amount and date.

5. Discussion

The main goal of the paper is to utilize ORM technique for describing the REA value model that is traditionally depicted by UML notation. Although the paper starts with business process modeling it also stresses the database design as the database provides structure and functionality for usually all software applications dealing with an enterprise. The REA value model plays a principal role in the REA enterprise ontology. This ontology is closely connected with object-oriented approach and that is why it utilizes UML notation for business process modeling. UML can offer a more compact notation, especially for the design of object-oriented software, and includes several mechanisms for modeling behavior. ORM notation belongs to the other techniques focused on data modeling, in particular conceptual data modeling. It was generally founded to be more expressive graphically, simpler, easier to validate and more stable. For data modeling, ORM offers several advantages at the conceptual analysis phase, while UML provides greater functionality for specifying a data model at an implementation level suitable for the detailed design of object-oriented code. Hence it seems worthwhile to provide tool support that would allow users to gain advantages of performing conceptual modeling in ORM, while still allowing them to work with UML.

6. Conclusion

Apart from traditional entity relationship approach for modeling database application there are other popular techniques mainly the Unified Modeling Language (UML) and Object-Role Modeling (ORM). Comparative evaluation of these approaches indicated that UML has benefits for object-oriented code design, which includes greater functionality for specifying a data model at an implementation level suitable for the detailed design of object-oriented code. On the other hand, ORM technique has advantages in conceptual analysis phase, particularly semantic stability, and graphical expressibility. For this reason a complete development cycle may well profit by using ORM as a front end to UML.

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INFORMATION SECURITY OF SYSTEM OF CONTINUOUS INTERNAL MONITORING AND AUDITING IN BANK

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ABSTRACT

Internal Continuous Monitoring (CM) and Continuous Auditing (CA) has become an inevitable trend in current banking business environment. Computer-aided auditing systems are widely used to complete this task in banks with geographically distributed branches. This increases operational risks relating with information protection in the information systems of the bank and at the transmission of information through aggressive environment - the Internet. Information safety CM / CA in the bank is based on confidentiality, integrity and availability of information. To select security system for these three postulates bank must analyze channels of information leakage, to determine the levels of control and choose one of the two options of protection: channel protection or protection the perimeter.

Safe work of CM / CA systems is reduces to decision three questions: first, should be given the rights to review any document for external users with the profile of the auditor; secondly, protect information from reading with the possible interception; thirdly, protect from leakage on the auditors computer. These problems can be resolved by using the proposed three-tier model of information security controls in CA / CM systems of Bank.

KEYWORDS

Information system, continuous monitoring, continuous auditing, operational risk, information security, bank, geographically distributed offices

1. Introduction

In the process of quality management in banks important role to play processes of Internal Continuous Monitoring (CM) and Continuous Auditing (CA). Distributed systems of Internal CM and CA are widely used in banks with geographically distributed branches. This increases operational risks relating with information protection in the information systems of the bank and at the transmission of information through aggressive environment - the Internet.

The internal auditor must have an access to almost all the information of the bank, he controls all the processes of the bank. Activity of internal auditor deserves special attention for purposes of security provision, because there is a possibility of information misrepresentation, falsification, indirect addressing, unauthorized destruction, misauthorization of payment documents [1-2].

Information security in the work of any bank is based on privacy, integrity and accessibility. To select the system for protection of these three postulate, the bank has to analyze the channels of information leakage, determine the levels of control, modes of protection and choose one of two options of protection: protection of channel or protection of perimeter. During the process of remote work of the auditor information security system must grant him external access to any information and provide security in the process of remote access. The conflict may arise between the requirements of the system of perimeter or channel protection and the necessity to transmit data for the work of the auditor. Model of the access

security during the process of conduction of the remote internal audit in the bank has to be designed to resolve the conflict. This issue is considered and solved in the present work.

2. Security matters in the performance of the internal CM and CA

The process of internal CM and CA is carried out according to standards [3-6] and may be divided into five types.

1. Internal CM and CA of documentation of the bank quality management system. The audit is performed by the auditors remotely. Documents are represented in electronic form. It includes audit of configuration, contents of regulatory documents and records. Main records considered by the standard ISO 9001 are inspected completely, records concerning business processes, standards of the processes, employment position instructions - selectively. On the basis of reports on business-processes estimation of quality relevant deviation of quality indicators is estimated. In point of fact this sub-process deals with the confidential information of few main processes, access to it has to be established remotely. Both an auditor and a bank security officer (owner of the business process of the bank information security) bear responsibility for the security.
2. Selective internal CM and CA of personnel and departments (surveys and interviews). It is performed within the territory of the bank and embraces two categories of workers: those responsible for fulfilling the requirements of standard ISO 9001; representatives of managerial personnel and average executives. Knowledge of main documentation, instruction, correspondence to the qualification requirements, availability of documentation at the local level and access to all the necessary electronic documents are examined selectively, among the individual workers. At this stage there is a risk of illegal, selective copying while accessing electronic documents. The auditor and the bank security officer are responsible for the sub-process.
3. Selective internal CM and CA of the business processes. It is performed within the territory of the bank. It includes supervision and survey of personnel on correspondence with regulations of business processes, their specific performance in the bank, inspection of availability of resources and the infrastructure for business processes, conformity of documents with their authenticated versions. The risk is in the fact that auditor may copy the data to his working laptop in order to check them thoroughly in quieter surrounding. There is a risk of loss of this laptop or copying data from it by the person concerned. The auditor and the bank security officer are responsible for the sub-process security.
4. The customer satisfaction CM and CA. It is performed within the territory of the bank and on the basis of channels of feedback by means of surveys. There is a risk of illegal copying of personal data as well as deliberate falsification. The auditor and the bank security officer should be held responsible for the sub-process security.
5. Internal CM and CA of service quality in the operational offices, usually conducted by the procedure "Mystery Shopper". When performing the internal CA it should be taken into account that the auditor deals with all the information technologies and systems of the bank. Main systems are:
   - Automated bank system and supporting systems for automatization of business processes;

- Software product of business modeling;
- CRM-system (Customer Relationship Management) - management of relationship and interaction of customers;
- Electronic document flow system;
- Channels of self-service.

Person responsible for the functioning of such systems is head of the IT service, though modern banks additionally use information security specialists for system maintenance to provide security of informational flows and data. If a bank buys and installs the software package for provision of security, the issue of integration of solution in security with the listed systems arises.

For the protection against unintended and deliberate destructive interference it is reasonable to include one more system that prevents information leakage, informs about the violation of security policy, monitors all the interferences to other information systems and can be considered as a guaranty of the information security of the bank. One of these systems is a circuit of information security SearchInform [7]. Use of the circuit could solve lots of problems connected with the peculiarities of performing of the internal audit because it could provide channel protection of the bank information.

3. Levels of control under the remote access

If special ancillary measures are not taken, information leakage control system will accept the work of an auditor under the remote access as a security violation.

The main aim of leakage protection is to identify the channel of leakage. Hereinafter e-mail, internet access, use of local printer or network printer and removable data storage devices should be considered such channels. There are three level of channels control: primary, secondary and tertiary [8]. At the first level we operate on the principle of: to deny access, to grant unilateral access, to grant bilateral access. Flash drives and compact disks are as a rule monitored at this level. This level is considered as the most inefficient. Programs that provide this service are not able to differentiate confidential information from public documents. They work in the mode: grant/deny access. User can either complete the operation via port or not. There is no content control, for example you cannot forbid copying of confidential information and allow copying of public information to flash drives. The same kind of thing happens on the workstation. If a worker has a permission to copy files to a flash drive he can copy any information. Use of special flash drives with enabled function of copying does not solve the problem.

If all the files, which are copied to flash drives, archived by the system to a special archive for the further analysis, it is called shadow copying. As a rule, shadow archives of each user are kept on the workstations. This does not make it possible to check the archives and considerably slows down the work of a workstation. Furthermore, it doesn't prevent information leakage but only registers it.

Secondary level of control is responsible for improper resource access by workers. It is used when the worker has a legal access to information channel. For example, establishing of quotas of printed documents enables to monitor the printing of extraneous documents that worker makes in his own interest. Billing solution which controls traffic belongs to the secondary level. Nevertheless, these functions are not related to information leakage, though they are useful for any company or state establishment.

At the tertiary level all the data from outside the corporate network are verified. All the files

undergo a content-control, attributes of the files (name, size, format etc.) are being verified. This is the very level that is designed to prevent information leakage. In point of fact the level of modern systems of corporate security is far from an ideal. Statistics shows this: about a quarter of total number of information leakage is not identified. That means the leakage has taken place but no one knows the way it has been done (apart from insider).

It should be noted that at the secondary and tertiary levels three working modes are possible: archive, monitoring and active protection. Copying of all the information which is beyond the perimeter of corporative network, and corresponding attributes (dispatch time, data of the sender, data of the network, to which the information had been sent) is characteristic for archiving. Checking of the archive is performed according to the regulations.

Monitoring represents an archive which has a function of signaling of some events, they may also be called incidents. Information before it is sent to the archive undergoes content and attributes checking according to the set rules. Rules are set beforehand by the data security officer by reference to the organizational security policy. If there is some coincidence of the content or attributes for the set rules which means that a security incident takes place, notification is being sent to the data security officer. As a rule, this notification arrives to the definite address of the electronic mail (data security officer's mail), an internet pager or SMS can be organized. As a matter of fact monitoring is a real step ahead compared with the archiving as it helps to define the insider, but nevertheless it does not prevent the leakage.

Active protection is the strongest mean against the insider's attacks. At revelation of transmitting of confidential information the suspension is carried out. Sending is possible only in case of automatic confirmation for the compliance to the rules that are set for this sender.

Remote work for the internal auditor is characterized by two opposite trends. On the one hand, auditor has the right of access to any documents and data of the bank. This can be provided giving him the right of the access to them. For example, in the system of leakage prevention auditor's profile receives the right of access to all the data.

On the other hand, viewing those files has to take place outside the corporate network. In such a way upon giving full access to the files, further actions of the auditor cannot be controlled because systems of control are restricted by the local network. Sending is being carried out through ambient environment where information leakage can take place.

4. Automatiozation of operating security of the Remote Auditor.

In such a way the safe performance of the internal auditor comes down to the solution of three issues: first of all, it is necessary to give the right of viewing any document to the external user with the profile of auditor; secondly, to protect the information from reading at potential interception; thirdly, to provide the protection from the leakage on the auditor's computer. These tasks can be solved in the next model, represented at Figure 1.

Communication session of the remote auditor with the local network begins with undergoing mutual authentication. At this point local network ascertains that it deals with the remote auditor and the auditor ascertains that he will work with the local network. We should note that in this situation the side which activates the process is represented by the auditor. That is why for undergoing authentication he has to apply strict authentication, for which purpose an electronic key – token can be used. No initial information from the auditor should come out in the open form, hereby encryption is extremely necessary. That is why it is necessary to synchronize token beforehand with the system of control of local network. For this aim a set of special cipher tables can be used. Authentication corresponds to the primary

level of control. At this level the archiving of communication sessions diary has to be made. System administrator is responsible for the primary level. After passing the primary level, auditor receives the rights of common user in the local network of the bank.

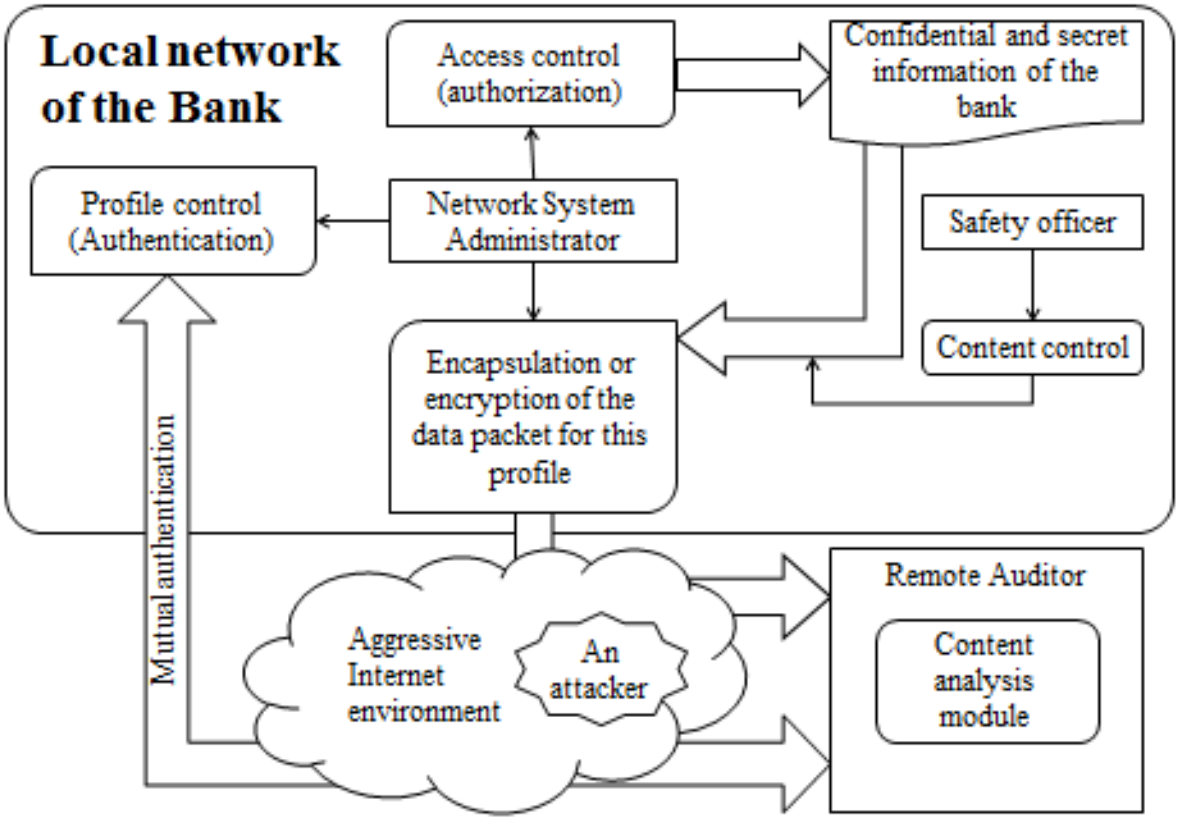

Fig. 1. Model of automatization of security by the remote access.

At the secondary level the authorization of the remote auditor takes place, the access to the bank resources is provided according to the status of the user-internal auditor. System administrator is responsible for the level. He carries out standard operations of billing, fixing quotas for time or volume, collects statistics. At this level it is reasonable to use monitoring mode.

After receiving the access to the resources of the bank local network, internal auditor begins his work. Before leaving the local network all the data has to be either encrypted by the session key of the auditor or VPN-connection (Virtual Private Network) has to be applied. System administrator of network is responsible for this. On the tertiary level data security officer is responsible for the content control. To perform the operations of content analysis the components of information security circuit have to be installed on the auditor's laptop, their set is the same as for any working station of the local network. Requirement for exchange of information between modules of content analysis on the auditor's laptop and security centre which is situated in the local network is the same as for the data – information has to either undergo encrypting or VPN-connection has to be used. For unification of the process using VPN-connection appears to be more correct. In such a way from the point of view of the data security officer the work of the remote auditor does not differ in any way from the work of any user of local corporate network. That is why data security officer sets up the modules which correspond to different information transfer channels: e-mail, printing of documents, copying to the removable media, outgoing internet-messages in the same way as if the auditor worked within the corporate network. At this level the strictest and the most

effective mode of protection has to be applied – active protection which stops the operation of information transmitting through the channel.

5. Conclusions

Modern systems of information leakage prevention are able to ensure content analysis at the remote working mode of the internal auditor. For this purpose, special modules - agents of channels security, have to be installed on auditor's computer. Primary and secondary levels of control have to be supported by the system administrator. That way, full automatization of remote work security with the function of control of all levels can be provided.

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APPLYING THE COMBINATIONAL HASHING OF AUTHENTICATION DATA IN INTERNET-PAYMENT SYSTEMS

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ABSTRACT

The scheme of internet transaction, based on cardholder's on-line own code, and three factors authentication during its realization are analyzed in the article. It is proposed to use combinational hashing scheme as a method of increasing the level of security in internet-payment system and implemented the evaluation of its quality.

KEYWORDS

Iinrternet-payment system, authentication, cardholder, OOC (online own code), HSC (hashing scheme code), collision

1. Introduction

Among the processes carried out in electronic payment systems the most vulnerable in sense of security is payment card requisites transmission, which is used for cardholder authentication. Since payment card requisites are actually open data embossed on the very card and hence can be easily disclosed as the result of security rules violation, banks are recommended to generate special code for internet payments (OOC – online own code) which is to be attached to a card account and is aimed to substitute other requisites for cardholder authentication and account balance checking when committing internet payments. The code is dynamic since it is generated for every transaction. Apparently the introduction of OOC is not sufficient for total security. Additionally hashing is utilized to counter data interception when carrying out cardholder authentication [1].

2. Problem area description

Combinational hashing algorithm, which is applied to the data transmitted to an internet payments system server in the process of cardholder authentication, involves the input of two data arrays:

- data which is to be hashed prior to being transmitted to the server; in this case - OOC;
- hashing sequence (HSC – hashing scheme code).

Apart from OOC cardholder also gets one of hashing combinations - HSC. This sequence is also known on server side, hence there is no need in transmitting it every time when a transaction is committed. The schema involves the usage of 9 different hash functions simultaneously (RSHash, JSHash, PJWHash, ELFHash, BKDRHash, SDBMHash, DJBHash, DEKHash, APHash). Herewith all of them process the same input, in this case – string representation of OOC. The outputs of all hash functions are concatenated to the single data field 288 bits long (every hash function outputs 4 bytes data field, so total length of 9 outputs comprises 36 bytes or 288 bits). The order in which these hash functions are called is defined by Hashing Scheme Code (HSC). HSC is 9 bytes long string, every char of which represents definite hash function.

Generally the scheme of internet-transaction, in which the combinational hashing is used, involves 10 steps:

1. Cardholder sends SMS message to the processing centre of his bank in order to obtain OOC.
2. Processing centre authenticates cardholder by phone number, generates OCC for him and sends back to the cardholder with SMS message. From now OCC is attached to the card account for the following transaction. OOC is to be generated again for every further transaction.

3-4. Cardholder inputs required data: OOC for authentication and other data that concerns some commodities purchase. OOC then is to be hashed with combinational schema using all 9 hash functions (RSHash, JSHash, PJWHash, ELFHash, BKDRHash, SDBMHash , DJBHash , EKHash, APHash). This data is sent to internet payments system server.

Server of an internet payments system receives hashed data and redirects it to a processing centre of the issuing bank. Processing centre having all required data recalculates hashed value and compares it with the received one.

5-6-7. If the comparison shows equality processing centre sends SMS message to the cardholder for transaction confirmation. After transaction is confirmed by the cardholder processing centre withdraws the demanded sum of money from the client's account.

8. Processing centre of the seller's bank sends the respond that the sum is accepted.
9. Processing centre of the issuing bank sends to the server of internet payments system a message that affirms that cardholder is valid and informs that money transfer is committed.
10. Processing centre informs cardholder that money transfer was successfully done. The transaction is over. (Figure 1).

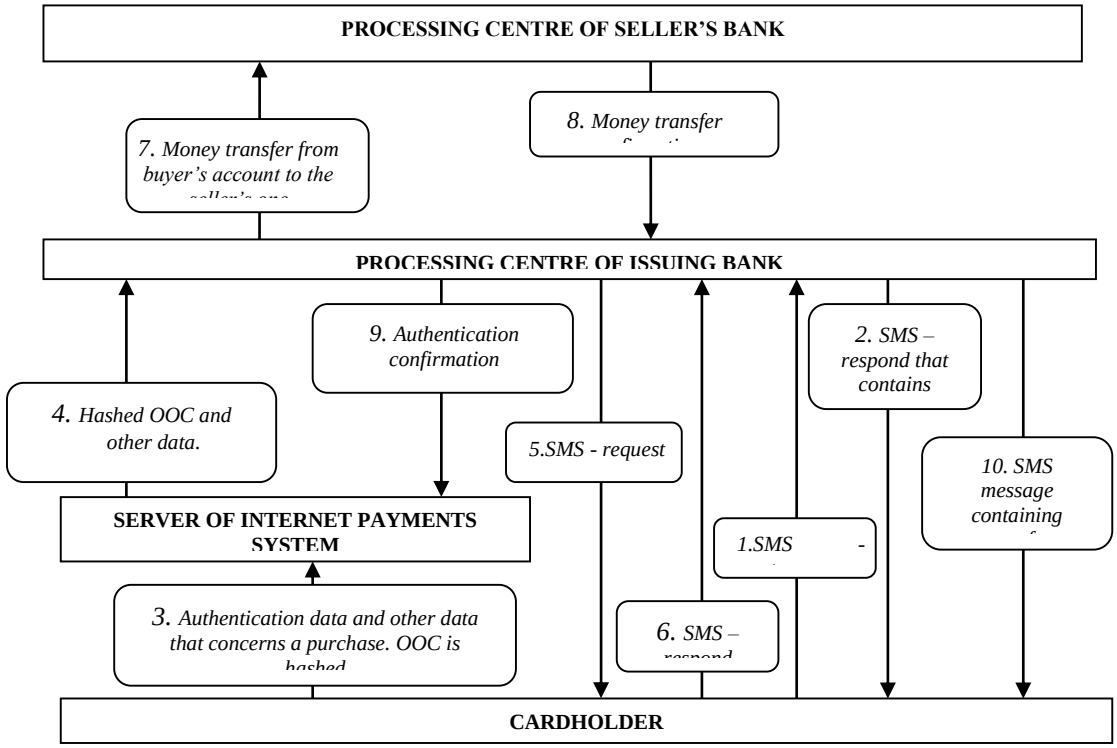

Figure1 Combinational hashing of the authentication data in the internet-payment system Source: own study

It is apparent that both sides are to be able to calculate hashed value by the same combinational schema described here. Payer generates hashed value on his side and sends it to the other side. In its turn the recipient of the hashed value must recalculate it and compare with the obtained one. The complete identity of both values is required for successful authentication. Since hashed value must be calculated identically, both sides must have identical software to do this. In order to be compatible with different software solutions the code is compiled in the form of dynamically linked library (hashCascade.dll). Having some HSC a solution may obtain the required hashed representation of any data (say OOC) by calling the interface method of the library. The role of the hashing library in payment system's authentication routines is shown in the figure below (Figure 2):

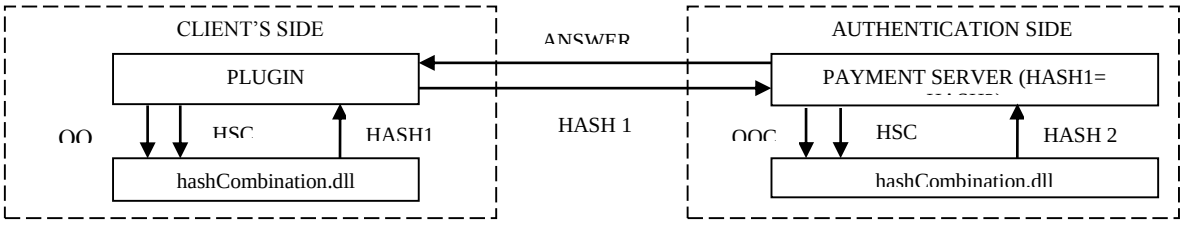

Figure 2. Program authentication scheme with combinational hashing in internet-payment systém Source: own study;Key: HSC – hashing scheme code, OOC - online own code

Hashing schema quality involves two components – collision probability and computational complexity. It is important for every hash function to have a negligible value of collision probability. Given k randomly generated values, where each value is a non-negative integer less than N. Given a space of N possible hash values, suppose you've already picked a single value. After that, there are N-1 remaining values (out of a possible N) that are unique from the first. Therefore, the probability of randomly generating two integers that are unique from each other is: $\frac{N-1}{N}$ (1). After that, there are N-2 remaining values (out of a possible N) that are unique from the first two, which means that the probability of randomly generating three integers that are all unique is: $\frac{N-1}{N}\times\frac{N-2}{N}$ (2). In general, the probability of randomly generating k integers that are all unique is: $\frac{N-1}{N}\times\frac{N-2}{N}\times\ldots\times\frac{N-(k-2)}{N}\times\frac{N-(k-1)}{N}$(3).

Since the probability of randomly generating k integers out of N that are all unique is determined by expression $e^{\frac{-k(k-1)}{2N}}$(4), the opposite possibility – possibility that not all of them are unique – is complementary (that is the sum of two possibilities equals to 1) and is estimated as 1 minus expression (4) result. That gives us expression (5):

$P = 1 - e^{\frac{-k(k-1)}{2N}}$ (5). Formula (5) can be approximated: $P = 1 - e^{-X} \approx X$ (6). So for small collision probabilities, we can use the simplified expression: $P = 1 - e^{\frac{-k(k-1)}{2N}} = \frac{k(k-1)}{2N}$ (7). Furthermore, if it is talking about more than a handful of k, there isn't a very big difference between k(k-1) and k^2. So the absolute simplest approximation is just: $P = \frac{k^2}{2N}$ (8).

Having N and using expression (4) we can build hash collision probability graph. Here is a graph for N=232. This illustrates the probability of collision when using 32-bit hash values. It's worth noting that a 50% chance of collision occurs when the number of hashes is 77163. Also note that the graph takes the same S-curved shape for any value of N (Figure 3)[4;6;7].

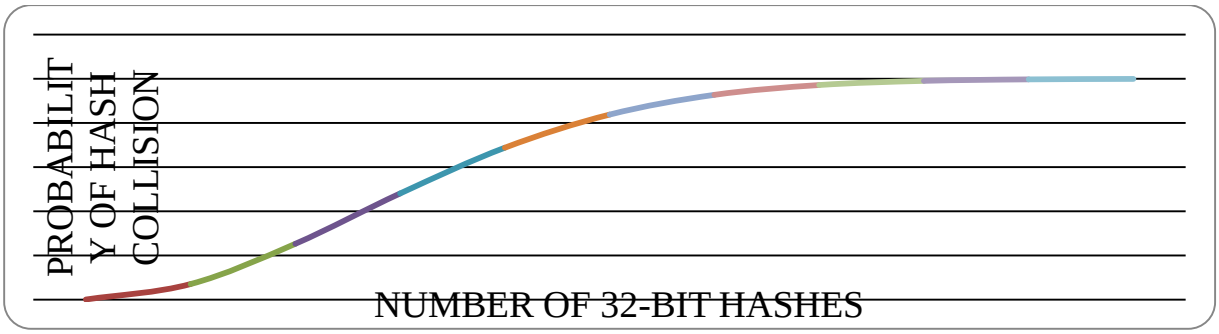

Figure 3. Dependency of hash collision probability on number of 32-bit hashes (N=232); Source: Hash Collision Probabilities, 2011, (online) http://preshing.com/20110504/hash-collision-probabilities

We would like to admit that graph's character is the same for any value of N. The number of hashes with which collision probability equals to 50% is important hash function quality index. Let's calculate its value for nine 32-bit hash functions: RSHash, JSHash, PJWHash, ELFHash, BKDRHash, SDBMHash, DJBHash, EKHash, APHash. To this end we solve the following equation: $0{,}5 = \frac{k^2}{2^{32}}$ => k=65536.

The obtained value k shows that if some 32-bit hash function generates 65536 outputs there will be at least one collision among them with 50% probability. Naturally this value (k) should significantly increase at the increase of N and should decrease at collision probability decrease. The following table contains values of k for corresponding values of N and p. (table 1). This is extended table, based on the table from [4].

Table 1. Collision probabilities for hashes of different lengths; Source: Hash Collision Probabilities, 2011, (online) http://preshing.com/20110504/hash-collision-probabilities

Number of hashes				Collision probability (p)
32-bit	64-bit	160-bit	288-bit	
77163	$5.06^{\times}10^{9}$	$1.42^{\times}10^{24}$	$2.2301^{\times}10^{43}$	0,5
30084	$1.97^{\times}10^{9}$	$5.55^{\times}10^{23}$	$9.9732^{\times}10^{42}$	0,1
9292	$609^{\times}10^{6}$	$1.71^{\times}10^{23}$	$3.1538^{\times}10^{42}$	0,01
2932	$192^{\times}10^{6}$	$5.41^{\times}10^{22}$	$9.9732^{\times}10^{41}$	0,001
927	$60.7^{\times}10^{6}$	$1.71^{\times}10^{22}$	$3.1538^{\times}10^{41}$	0,0001
294	$19.2^{\times}10^{6}$	$5.41^{\times}10^{21}$	$9.9732^{\times}10^{40}$	0,00001
93	$6.07^{\times}10^{6}$	$1.71^{\times}10^{21}$	$3.1538^{\times}10^{40}$	0,000001
30	$1.92^{\times}10^{6}$	$5.41^{\times}10^{20}$	$9.9732^{\times}10^{39}$	10^{-7}
10	607401	$1.71^{\times}10^{20}$	$3.1538^{\times}10^{39}$	10^{-8}
	192077	$5.41^{\times}10^{19}$	$9.9732^{\times}10^{38}$	10^{-9}
	60740	$1.71^{\times}10^{19}$	$3.1538^{\times}10^{38}$	10^{-10}
	19208	$5.41^{\times}10^{18}$	$9.9732^{\times}10^{37}$	10^{-11}
	6074	$1.71^{\times}10^{18}$	$3.1538^{\times}10^{37}$	10^{-12}
	1921	$5.41^{\times}10^{17}$	$9.9732^{\times}10^{36}$	10^{-13}
	608	$1.71^{\times}10^{17}$	$3.1538^{\times}10^{36}$	10^{-14}
	193	$5.41^{\times}10^{16}$	$9.9732^{\times}10^{35}$	10^{-15}
	61	$1.71^{\times}10^{16}$	$3.1538^{\times}10^{35}$	10^{-16}
	20	$5.41^{\times}10^{15}$	$9.9732^{\times}10^{34}$	10^{-17}
	7	$1.71^{\times}10^{15}$	$3.1538^{\times}10^{34}$	10^{-18}
			$9.9732^{\times}10^{33}$	10^{-19}
			$3.1538^{\times}10^{33}$	10^{-20}
			$3.1538^{\times}10^{28}$	10^{-30}
			$3.1538^{\times}10^{23}$	10^{-40}
			$3.1538^{\times}10^{18}$	10^{-50}
			$3.1538^{\times}10^{13}$	10^{-60}
			$3.1538^{\times}10^{8}$	10^{-70}
			3.154	10^{-80}
			10	10^{-85}
			3	10^{-86}

The table shows the number of hashes of some length needed to achieve collision probability of the last column. Several standard lengths were taken for comparison: 32 bits long hash result, 64 bits long hash result, 160 bits long result and 288-bit hashes. The latter is concatenation of 9 32-bit hash functions. Every of those hash functions outputs 32 bits long result. It is convenient for 32-bit hardware architecture but also tends to have higher collision probability. It is apparent from table 1 that growth of hash length exponentially causes collision probability decrease. The results for usual 32-bit hash function and those for aggregated 288-bit one are especially contrast. For 50% collision probability the number of 288-bit hashes is as much as 2.8901*1038 times greater that the number of 32-bit hashes. It is enormous number. On the other hand collision probability for 32-bit hashes exhausts on the minus ninth order of magnitude (1 out of 100 millions), whereas for 288-bit hashes collision probability can reach minus 86-th order of magnitude.

It is apparent that temporal complexity of the aggregated hash function algorithm depends on temporal complexity of included hash functions. All nine hash functions are equal in that that they possess linear complexity. That is execution time is proportional to input data length. All of them contain one for cycle that iterates input string and all operations are carried within this cycle. Those operations do not involve other cycles or recursive calls. They mainly consist of comparatively simple numeric operations which take fixed time: addition, multiplying, shifts, or, xor logical operations. Taking this we can state that time complexity of the algorithm O(n)= xn, where n – length of an input string, x – some index. Since computational complexity is calculated asymptotically (that is input length n tends to infinity) we can define computational complexity of any hash function as O(n).

The proposed hashing schema involves consistent calls of nine hash functions with common input data. That is why time complexity of the aggregated hash function can be defined as O(9n). Taking into account complexity's properties this equals to O(n). On the other hand it is clear that fixed number of calls of linear functions is also linear algorithm. Hence we can conclude that temporal complexity of the proposed aggregated hash function and that of other hash function are comparable and are equal to O(n). This means that substitution of any of hash functions with the aggregated one must not lead to considerable augmentation of computational resources usage. [4;5].

3. Conclusions

Hence the proposed internet payments transaction scheme does not involve payment card requisites transmitting. This is achieved by introduction of dynamic OOC and its secure transmitting to a server with the help of combinational hashing. Taking into account the researches of the schema's quality we can characterize it as follows:

- since every hash function is irreversible the aggregated has function is also irreversible;
- aggregated hash function can process input data of any length;
- aggregated hash function is much more reliable. For 50% collision probability the number of 288-bit hashes is as much as 2.8901*1038 times greater that the number of usual hashes;
- the introduction of aggregated hash function does not lead to significant increment of computational complexity, hence does not cause the increase of execution time.

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MATHEMATICAL MODELING STRATEGY OF PRICE POLICY BANK

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ABSTRACT

The method for forming a strategy of pricing policy bank based on economic-mathematical modeling with using the theory of production functions, differential equations and mathematical games are presented. We construct a dynamic model as a continuous optimization problem and the method to solve it. The software for the numerical realization of the problem are designed and tested on the example of Privatbank in Ukraine.

KEYWORDS

Bank strategy, interest rates, production functions, integro-differential equations, mathematical game theory, optimization, Hurwitz criterion

1. Introduction

Ensuring financial stability of commercial banks in today's successful strategy depends on Banking, part of which is the pricing policy of the bank. The main content pricing is the pricing of banking products and change according to market conditions. The main objects of the pricing policy is interest rates. Each bank as a business loan and deposit market is trying to realize their interests by the stipulation that influence the pricing policy of the central bank and the specific conditions of the financial market. Commercial bank deposit policy aims at optimizing the cost of raising funds in the deposit market conditions for their effective use. However, the increase in the share of expensive deposit instruments leads to an increase in interest expense on the other hand, a high proportion of low resources improves profitability, but also leads to a decrease in the liquidity of the bank (Bartosh,2008). Therefore, before each bank in an unstable economic situation there is a problem: to develop pricing strategies that would be attractive to consumers of banking services, meets the requirements of the National Bank of Ukraine and provided the banking institution.

In general, the theory of banking has significant experience in developing pricing strategies (Moroz,2002), (Tyrkalo,1999), (Gerasymovych,2003). Most approaches are based on linear pricing paradigm, meaning that prices are formed as the sum of average cost and expected return (Moroz,2002) or specific components of marketing: from break-even analysis and target profit of, tangible product value, taking into account the level of current market rates, based on the analysis of the relationship clientele, market penetration (Vasurenko,2008).

The fact that the methods of pricing strategies in the banking sector require further development, because it is static, and the market is dynamic, not adequately take into account the cost structure and rarely consistent with the overall strategy of banking. In addition to marketing approaches, there are also economic-mathematical methods of pricing in the bank (Kapustyan, 2011), consistent with the overall strategy of banking, often take into account external influences, but mainly based on a linear approach analysis of financial dynamics.

Problem definition

The aim of the study is to develop economic-mathematical method of pricing strategies in the banking sector, which allows you to create pricing strategy based on dynamic nonlinear models based on integrating theories of production functions and optimization of

bank implements its mission and supports external changes. This model predicts relationship pricing of credit-deposit banks and takes into account external influences, and it provides a dynamic unity of the past with the future. This strategy allows you to build consistent, flexible and mobile.

Let's make some assumptions and clarify the problem. Consider a bank as a financial institution that provides credit and deposit activities and provides trading on the interbank market. Let the bank uses credit and deposit instruments, different amounts and interest rates. They form the corresponding portfolio: credit and deposit. Competition in the market implies the existence of a number of financial firms, each of which at each time selects its strategy of Conduct. To ensure the achievement of certain targets banking institution may make adjustments in interest rates. Mathematical modeling of production - organization of commercial banks based on their interpretation of how financial firms, the technology of which is described by a production function (Kvasniy,2010).

2. Construction of the model and algorithm for solving

Based on analysis of the impact of both external and internal factors on the behavior of deposits (Vasurenko,2008), for modeling fundraising commercial bank under uncertainty proposed dynamic model:

$$\begin{cases} G_i = \dfrac{1}{t_2 - t_1}\displaystyle\int_{t_1}^{t_2} \frac{\left(\sum_{k=1}^{n} K_{ki}(t)p_{ki}(t) + M_i(t)p_i(t) - \sum_{d=1}^{m} D_{di}(t)p_{di}(t) - Y_i(K(t), D(t))r\right)N_i(t)}{\sum_{k=1}^{n} K_{ki}(t)p_{ki}(t) + M_i(t)p_i(t) - \sum_{d=1}^{m} D_{di}(t)p_{di}(t) - Y_i(K(t), D(t))} dt \to \max \\ L_i = \dfrac{1}{t_2 - t_1}\displaystyle\int_{t_1}^{t_2} \frac{\sum_{k=1}^{n} K_{ki}(t)(1 + p_{ki}(t)) + M_i(t)(1 + p_i(t))}{\sum_{d=1}^{m} D_{di}(t)(1 + p_{di}(t))} dt \\ \dot{D}_i = f(G_i(t), L_i(t)) \\ \dot{D}_i = A_i G_i^{\mu_i}(t) L_i^{1-\mu_i}(t) \\ M_i(t) = (1-\alpha)D_i(t) - K_i(t) \\ \sum D_i \geq \sum M_i + \sum K_i \\ \dfrac{D_i + D_{i-1}}{D_i} \leq 1 \\ K_i(t) = \nu(t) D_i(t) \\ L_i \geq 1 \end{cases} \quad (1)$$

Where G_i - goodwill indicator which characterizes reputation, image is an estimate of the bank; L_i - Liquidity indicator that reflects how the loans secured by deposits (revealing the presence of imbalance);

$\dot{D}_i$ - Change deposits with the change of time;

$\dot{D}_i = f(G_i(t), L_i(t))$ - Integro - differential equation that models the attracting resources;

$f(G_i(t), L_i(t))$ - The bank's production function that describes activities aimed at attracting customers;

A_i - The coefficient of technologies of the bank to attract resources means goodwill and liquidity;

$K_{ki}(t)$- The volume of credit k applications, issued by the bank at time t;

$p_{ki}(t)$- Interest rate k loan program;

$D_{di}(t)$- Deposits program raised by the bank at time t;

$p_{di}(t)$ - Interest rate deposit program;

$M_i(t)$- Authorize the bank, located in the interbank market;

$p_i(t)$- Interbank interest rate;

$Y_i(K(t), D(t))$- Production function (the cost to implement the credit-deposit of the bank);

r - Average rate of profitability in the banking sector;

$N_i(t)$- Intangible assets of the bank, their original cost;

α - The rate of reserve money multiplier inverse;

$\nu(t)$- The share of loans in the deposit depends on external factors (GDP growth, inflation, exchange rate, wage growth) and internal (rates in the interbank market, technology management activity) (Tyrkalo,1999).

To simulate the pricing strategy of the bank offer to model (1) to apply the criterion of Hurwitz. Criterion recommends a strategy that is given by:

$$\max_i \left\{ \eta \min_j a_{ij} + (1-\eta) \max_j a_{ij} \right\}, \qquad (2)$$

Where η - the degree of optimism and varies in the range [0, 1].

This criterion follows some intermediate position, taking into account the possibility of both the worst and the best variant behavior: when the bank has full information, or do not possess. When η = 1 criterion becomes a Walde test (pessimistic), at η = 0 - the maximum criterion (optimistic). The value η affects the degree of completeness of financial information and banking risk management, those who make decisions on the choice of strategy.The greater loss of erroneous decisions, the greater the desire to insure and therefore η close to 1. Since the Bank's policy is to maximize the credit rate and minimize deposit and customer requirements contrary to maximize and minimize credit deposit, then the following conditions Hurwitz criterion gives the best solutions to the conflict (Bartosh,2008).

To implement the optimization problem (2) use numerical method, in particular, the transition to a sequence of discrete ratios. Since, at any given time production function is a constant that is determined by the new values of goodwill and liquidity, for the calculation of such deposits obtain recurrence relations:

$$D_{n+1} = D_n + (t_{n+1} - t_n) A G_n^{\mu} L_n^{1-\mu}$$

$$G_n = \frac{(K_n p_{kn} + M_n p_n - D_n p_{dn} - B K_n^{\beta} D_n^{1-\beta} r) N}{K_n p_{kn} + M_n p_n - D_n p_{dn} - B K_n^{\chi} D_n^{1-\beta}}$$

$$L_n = \frac{K_n (1 + p_{kn}) + M_n (1 + p_n)}{D_n (1 + p_{dn})}$$

(3)

Find D_{n+1} substituted in the necessary condition of maximum profit and obtain equations for calculating p_{kn} and p_{dn}:

$$p_{kn} - p_n = \beta B K_n^{\beta-1} D_n^{1-\beta}; \; p_n(1-\alpha) - p_{dn} = (1-\beta) B K_n^{\beta} D_n^{-\beta}.$$

(4)

In this system of equations we add a condition on the rate of return (the National Bank of Ukraine margin requirements): $p_{kn} - p_{dn} = d$ or a condition on the amount of the loan $\nu_1 D_n \le K_n \le \nu_2 D_n$. (5)

For given parameters A, μ, B, β and initial conditions is calculated as follows: K_{n+1}, $p_{kn=1}$, $p_{dn=1}$, and again for them to figure out something new $D_{n=2}$. In terms of income find the interest rate that maximizes profit for the bank is the best. But the credit and deposit market has a number of banks and their offer may be more attractive to potential customers.

This problem can be solved using the mathematical theory of games. Apply Hurwitz criterion (2) to an optimization problem (3)-(5), we obtain equations for constructing strategies of interest rates:

$$\text{Credit - } \max_k \left\{ \eta \min_i p_{ki} + (1-\eta) \max_i p_{ki} \right\}$$

$$\text{Deposit- } \max_d \left\{ \eta \min_i p_{di} + (1-\eta) \max_i p_{di} \right\} \quad (6)$$

On the basis of the relations (3)-(6) management of the bank is able to calculate the strategy, taking into account interest rates completeness of information on internal and external environment of the bank. Given that commercial bank operating under uncertainty about their competitors and permanent dynamic financial area, the parameters of the production function are variable in time.

3. Conclusions

The study found factors that influence the growth of the bank and the type studied their effects. A model of credit and deposit the bank on the basis of production functions. Economic-mathematical model of banking, which involves the growth of fundraising, providing for their efficient allocation and account restrictions the National Bank of Ukraine is built. This model allows us to take into account the instability of the environment and the behavior of competitors. The developed based on mathematical theories games, optimization and integro-differential calculus. The proposed model can be implemented for both individual banks and groups of banks. To implement the proposed mathematical model of bank pricing strategy program compiled with Delphi environment and tested on data from Privatbank of Ukraine. This model can be used in the banks when developing strategic plans.

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APPLYING KANBAN PRINCIPLES TO SOFTWARE DEVELOPMENT

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ABSTRACT:
Kanban has been used in manufacturing for more than two decades, but it is a relatively new concept in the area of software engineering. Although the number of Kanban users grows rapidly and the early adopters report significant improvements in their development process, there are still many open questions regarding Kanban implementation in practice. The paper describes our experience with an experimental Kanban project that we conducted (1) to find the best way of applying Kanban principles to software development by experimenting with different Kanban boards and WIP limits in a near to real software development project, and (2) to study the possibilities for using Kanban within the scope of the capstone course, which students take in their last semester. The paper provides an overview of Kanban, describes the results of the aforementioned project, and discusses some important issues regarding Kanban implementation: the choice of appropriate columns and WIP limits on the Kanban board, and the incorporation of Scrum practices to ensure better project management.

KEYWORDS:
Software development, Kanban, agile methods, project management, Scrum

1. Introduction

Kanban was developed as a scheduling system for lean and just-in-time production and represents a well-known and effective tool in support of running a production system as a whole and promoting improvement (Ohno, 1988). While Kanban has been used in manufacturing for more than two decades, it is a relatively new concept in the area of software engineering (Anderson, 2010). A recent review of Lean-Kanban approaches to software development (Corona and Pani, 2013) revealed that there was almost no paper published on this topic in the scientific literature. Nevertheless, some early adopters report significant improvements in their development process (e.g., Sjøberg et al., 2012; Anderson et al., 2012) and the latest state of agile development survey (VersionOne, 2013) indicates a rapid growth of the number of Kanban users. While Scrum (Rising and Janoff, 2000; Schwaber, 2004) and its variants are still the most popular agile methodologies being used, Kanban and Kanban variants nearly doubled in 2012, mostly due to an uptick in Scrumban use (Ladas, 2008). Therefore, applying Kanban approach to software development seems to be a hot topic for software researchers and practitioners.

The main goal of Kanban is to maximize the workflow and shorten the lead time (i.e., the average time to complete one item) by limiting the amount of work in progress (WIP). In order to visualize the workflow, a Kanban board is used, which consists of several columns, each column representing a stage in the development process. The number of work items in each column is limited, thus forcing the developers to concentrate on the work in progress and not start a new piece of work until the previous one is completed.

Although the basic idea of limiting the work in progress is very simple, the results reported by the currently available studies are impressive. Sjøberg et al. (2012) describe the case of a Scandinavian company, which after the introduction of Kanban almost halved

the lead time, reduced the number of weighted bugs by 10 percent, and improved productivity. Similarly, Anderson et al. (2012) report experience from a Microsoft's maintenance project indicating that the typical lead times, from the arrival of a request to its completion, reduced from 125–155 days to only 14 days after successful implementation of Kanban.

Due to limited evidence of Kanban use in software development there are still many open questions regarding its implementation in practice, e.g., how the Kanban board should like, how to set the WIP limits, how to combine Kanban with other agile practices and methods, what tools are available for managing the Kanban process, etc. The aim of this paper is to shed some light on the aforementioned issues by describing our experience with an experimental Kanban project that we conducted with a group of graduate students at the University of Ljubljana. The development team consisted of 3 students who worked on the project as developers, and a teacher who played the role of (in Scrum terminology) the Product Owner. The aim of the project was twofold: (1) to find the best way of applying Kanban principles to software development by experimenting with different Kanban boards and WIP limits in a near to real software development project, and (2) to study the possibilities for using Kanban within the scope of the capstone course, which undergraduate students take in their last semester. In order to additionally enforce in-depth treatment of possible ways how to use Kanban in practice, the project required the development of an automated web based tool to help keeping track of the Kanban process.

In the remainder of the paper, an overview of Kanban is provided first, followed by a description of the aforementioned experimental project. Then the choice of appropriate columns and WIP limits on the Kanban board is discussed. Finally, it is presented how Kanban and Scrum practices were combined in order to manage the project.

The aim of the paper is to increase the body of knowledge regarding the use of Kanban in software development. Our experience confirms that Kanban is definitely useful in software maintenance, while a combination of Scrum and Kanban improves the management of development projects.

2. Kanban in Software Development

Kanban introduces lean manufacturing practices to software development in order to improve productivity, shorten the lead time, and eliminate waste (Anderson, 2010; Kniberg and Skarin, 2010). It has recently become popular because of its ease of implementation, use of visual controls, ability to accommodate a wide variety of organizational design patterns, integration of stakeholders and relentless focus on the continuous delivery of value (Cottmeyer and Stevens, 2012).

Kanban derives its name from the use of signal cards to manage the flow of work in a manufacturing environment. The kanban (which is a Japanese term meaning signal card) implies that a visual signal is produced to tell an upstream step in a process that new work can be started because current work is below the agreed limit. This mechanism is known as a "pull" system: new work is "pulled" into the system when there is capacity to handle it, rather than being "pushed" into the system from the outside.

Kanban is based on a very simple idea: Work in Progress (WIP) should be limited and something new should be started only when an existing piece of work is delivered or pulled by a downstream function. WIP limit defines the capacity of each step in the development process in terms of the number of work items that may be in progress at each workflow state. Appropriate WIP limits ensure that a pull system cannot be overloaded, thus making it possible to maintain a sustainable pace of development. Only the workers at the bottleneck are fully loaded; everyone else should experience some slack time. On the other hand, WIP

limits quickly bring to light issues that impair performance. When work cannot move forward because the WIP limit has been reached in the next state, it makes the current constraint on the system highly visible, thus forcing the team not to take more work until the problem with the constraint is fixed.

In order to be used for software development, Kanban requires the work to be split into pieces. Since Kanban is mostly used in combination with agile methods, each work item is usually represented as a user story written on a paper note card (Cohn, 2004). If necessary, user stories are further divided into constituent tasks. For the purpose of planning and performance measuring, it is recommended that all work items are of approximately the same size. However, Kanban prescribes neither the structure nor the size of work items.

Work items must be presented on a Kanban board, which serves as a visual control mechanism indicating how the work flows through the various stages of development process. Typically, a whiteboard with sticky notes, or an electronic card wall system is used. Two examples from our project are shown in Figures 1 and 2.

The Kanban board consists of a sequence of columns that represent the various states a work item can exist in during the development process. As work progresses through the development lifecycle, the cards move from one state to the other, until they finish in the last column. Each column has on its top a WIP limit indicating how many cards can be in the corresponding workflow state at any one time. When a card is completed in one column, it moves to the next, thus creating an open space in its current column, which allows the development team to pull a completed card from a previous column. If, for any reason, cards in one column cannot be completed and moved forward, this column sooner or later hits its WIP limit, which prompts the development team to fix the bottleneck instead of just piling up a whole bunch of unfinished work.

Kanban uses the lead time (i.e., the total elapsed time from when the work item was started until it is declared complete and accepted by the customer) as a major measure of the development team throughput and productivity. Lead time is useful for predicting delivery and making service level commitments. If user stories are broken down into similarly sized increments of work, effort estimation is no longer even necessary and the lead time becomes the only metric needed to measure the delivery capability of the team.

By providing team members and other stakeholders with visibility into bottlenecks and their impact on the development process, Kanban encourages collaboration among all parties involved and discussions about improvements, thus contributing to incremental evolution of existing processes and continuous improvement. As such, Kanban represents an approach to introducing change to an existing software development lifecycle or project management methodology. Kanban does not require revolutionary changes, but can be simply incorporated into an existing development process. It is only necessary to visualize the workflow, limit WIP, and measure the lead time. Kanban is most frequently combined with agile methods like Scrum (Ladas, 2008), but can also be used in combination with more traditional approaches based on the waterfall lifecycle model. It is expected that blending Kanban and agile methods can create tremendous value for software development organizations (Cottmeyer and Stevens, 2012).

3. Experimental Kanban Project

Kanban is less prescriptive than other software development methods and provides less constraints and guidelines compared to Scrum or Extreme Programming (which is considered more prescriptive than Scrum). It is not prescribed which columns the Kanban board should have neither what the WIP limits should be. Instead, Kanban users are expected

to experiment with the process and customize it to their environment. By changing values of different parameters (e.g., WIP limits) they must look for solution that best fits their development process. It is important that the impact of each change is closely monitored through an appropriate feedback loop in order to determine how the changes affect the lead time, queues, capacity, etc. One of the typical parameters to think about is the WIP limit. Too low WIP limit results in idle people and consequently low productivity. On the other hand, too high WIP limit causes idle tasks, which increase lead time.

In contrast to Scrum, Kanban does not prescribe roles, time-boxed iterations, effort estimation, and team commitment to a specific amount of work for each iteration on the basis of team's velocity. All these elements are optional and it is up to each team to decide the ground rules how they will be used.

In light of the above, we decided to start an experimental project, which should contribute to better understanding of Kanban use in practice, and allowed us to experiment with different Kanban boards and WIP limits. The project was conducted during the summer term of the Academic Year 2012/13. The development team consisted of three graduate students of Computer Science, while the teacher played the role of the Product Owner. The project required the development of a web based tool for managing Kanban projects.

Having previous experience with Scrum – all participating students completed the capstone course on agile software development using Scrum (Mahnic, 2012) during their undergraduate studies – we decided to use Scrum as a basis into which Kanban concepts would be incorporated. Therefore, the project consisted of Sprint 0 and three regular Scrum Sprints. Sprint 0 lasted 4 weeks, while each regular Scrum Sprint lasted 3 weeks. Another reason for using Scrum was a relative weakness of Kanban-style planning techniques. While Kanban's flow-based approach is well-suited for maintenance activities (where work items emerge randomly on a daily basis), development of new applications requires more advanced planning techniques offered by Scrum.

During Sprint 0 user stories were developed, prioritized and estimated using planning poker (Greening, 2002; Mahnic and Hovelja, 2012b). The Product Backlog consisted of 18 user stories describing required functionality for four different user roles: the system administrator, the Kanban Master, the Product Owner, and the development team members. Assuming that the Kanban Master is responsible for methodology, the tool was designed to offer him possibilities to define (and adapt) the structure of the Kanban Board, prescribe the WIP limits, and monitor progress through cumulative flow diagrams and burn-down charts. The Product Owner was supposed to define work items in form of user stories and decide when a user story is done. The development team members were given possibilities to estimate work items and move them form one workflow state (represented with the corresponding column) to another. The system administrator was assumed to assign each user his role and maintain the data required for the proper functioning of the system (i.e., data about developers, development teams, and projects they are working on).

The tool was designed to be as flexible as possible, giving possibilities to define a Kanban boards with an arbitrary number of columns (representing different workflow states) and rows (representing different projects a development can work on simultaneously). Each user was allowed to have several roles on the same project and play different roles in different projects. Special attention was devoted to specification of rules for moving work items from one column to another. For each column, the tool made it possible to define who (i.e., which user role) can move a work item to the next or previous column. In order to compute the lead time, each move was assigned a time-stamp, thus making it possible to determine how long a work item remained in each workflow state.

It was assumed that such a tool would cover the majority of needs of developers who use Kanban, and would be flexible enough to adapt to different workflows.

4. Kanban Board and WIP Limits

4.1 Sprint 1

During Sprint 1 we used the Kanban board in Figure 1. The board structure was adopted from the literature (Kniberg and Skarin, 2010, p. 44); we only added the column "Dev Ready" as a separate workflow state in order to stress that each user story should have been broken into constituent tasks before development started.

The "Backlog" column comprised the set of user stories that had to be developed in no particular order. The "Selected" column contained the high priority stories, with a WIP limit of 3 indicating that there could be at most 3 high priority stories at any given moment. The WIP limit of 3 was chosen because there were 3 developers working on the project. Whenever one of them was ready to start working on a new item, he could take a user story from the "Selected" column and move it to the "Dev Ready" column. This was a sign to the Product Owner to choose next story from the "Backlog" with the highest priority and fill up the free space in "Selected".

The Product Owner was allowed to make changes in the "Backlog" and "Selected" columns, but not the other columns. Within the WIP limit of the "Selected" column, he was allowed to change priorities by moving high priority stories from "Backlog" to "Selected" and vice versa. Whenever there had already been 3 user stories in the "Selected" column, one of them had to be moved back to "Backlog" before being replaced with a more urgent user story.

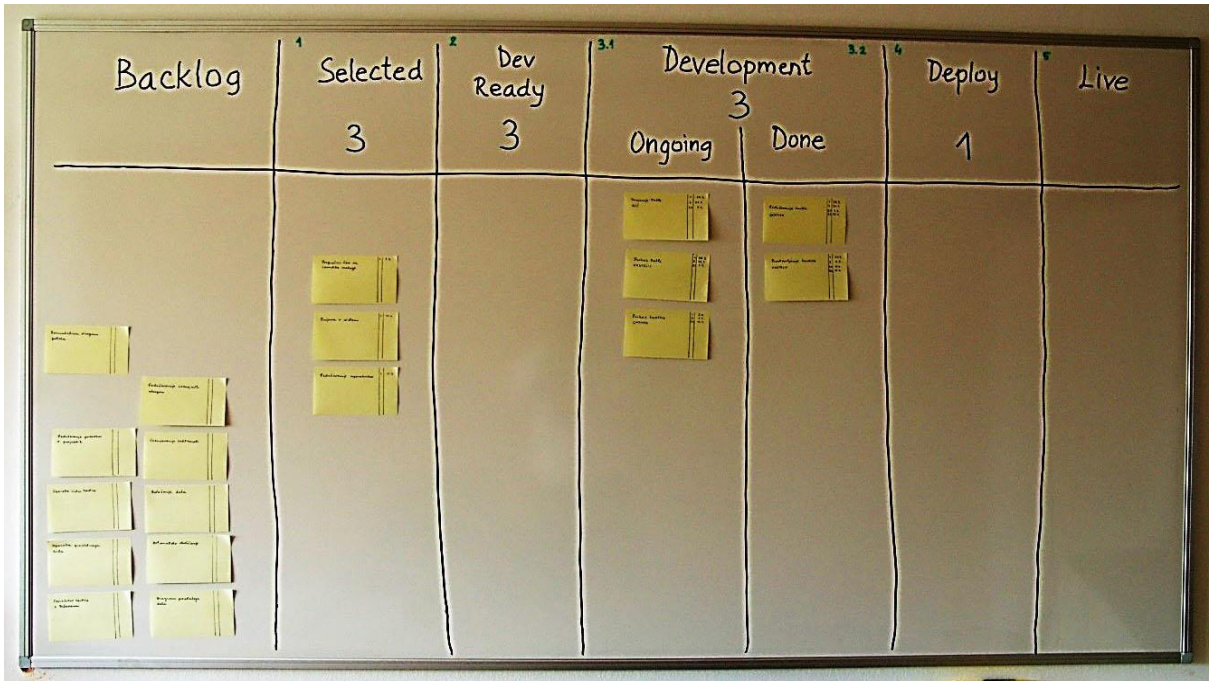

Figure 2 The Kanban board during Sprint 1

The "Dev Ready" column was introduced to force the developers to decompose the user story into tasks before actual development started. A story could only be moved to "Development" when the tasks required to turn it into a deliverable functionality had been defined.

The “Development” column was intended to show what was (at a given moment) being developed. It was split into two sub-columns “Ongoing” and “Done” in order to provide information, which stories were completed and could be put into production. The “Development” limit of 3 was shared among the two sub-columns to deter developers from starting new work items until (enough) completed stories were moved to “Deploy”. According to recommendations from the literature (Kniberg and Skarin, 2010), such a WIP limit gives developers a strong incentive to focus their efforts and mutual co-operation to get stuff into production, thus maximizing the flow and minimizing the lead time. For the same reason, the WIP limit of 1 was chosen for “Deploy”.

In Sprint 1 we started with rather tight WIP limits in order to make potential bottlenecks and anomalies in the process visible as soon as possible. Having 3 developers, it seemed reasonable to set the WIP limit of the “Selected”, “Dev Ready”, and “Development” columns to 3. While this limit worked well for “Selected” and “Dev Ready”, it appeared to be too low for the “Development” column. The main reason lay in peculiarities of our project setting, in particular in work division between developers (students) and the Product Owner (the teacher). User stories that developers (students) considered done still had to pass acceptance tests performed by the Product Owner (the teacher). These tests often revealed some deficiencies requiring the stories to be moved back to the “Ongoing” sub-column instead of going forward to “Deploy”. In the meantime, the developers (students) did not want to sit idle and started new work, which caused a violation of the WIP limit. An example of such a violation can be seen in Figure 1, where the “Development” column contains 5 work items instead of (at most) 3.

Sprint 1 also raised doubts about necessity of columns “Dev Ready”, “Deploy”, and “Live”. With regard to the “Dev Ready” column it became evident that decomposition of user stories into tasks (although representing an important step in the development process) was not time-consuming, and the great majority of stories left the “Dev Ready” column the same day they entered it. Consequently, the “Dev Ready” column was almost always empty. Columns “Deploy” and “Live” appeared to be less important since the project did not have a real user requiring the completed user stories to be put in production.

Considering the aforementioned findings, the Kanban board was restructured at the beginning of Sprint 2 and after that remained unchanged till the end of the project.

4.2 Sprints 2 and 3

The Kanban board used in Sprints 2 and 3 is shown in Figure 2. Apart from increasing the WIP limit of the “Development” column and removing columns “Dev Ready”, “Deploy”, and “Live”, the board was further adapted to fit the Scrum process.

For the purpose of planning, it was decided to define the content of each Sprint by strictly following Scrum rules. Consequently, the “Selected” column was introduced to contain the stories to be developed in the next Sprint, with the WIP limit expressed in terms of velocity, i.e., the number of story points that the team was expected to complete. At each Sprint planning meeting the corresponding stories were transferred form the “Backlog” column to “Selected”.

The “Next” column served for the same purpose as the “Selected” column in Sprint 1; it contained the high priority stories defined by the Product Owner. Whenever a developer was ready to start working on a new item, he could take a user story from the “Next” column and move it to the “Development Ongoing” sub-column. The WIP limit of the “Development” column was doubled, thus allowing each developer to work on two stories simultaneously.

Besides developing a new user story, a developer could also work on a story that had been rejected by the Product Owner and sent back to “Development”.

The notion of “done” was defined more precisely; consequently, the former “Done” sub-column was split in two and the “Acceptance” column was introduced. The “Done” sub-column within “Development” was used to contain those user stories that developers considered completed, thus letting the Product Owner know that he could start with their evaluation. Stories under evaluation were moved to the “Acceptance” column. If approved by the Product Owner, each story proceeded to the final “Done” column, indicating that it was fully completed. Otherwise, the story was returned to the “Ongoing” sub-column in order to remove shortcomings detected during “Acceptance”.

Since it was agreed that each story had to be fully integrated before entering the acceptance procedure (and since there was no real production system), the “Deploy” and “Live” columns were no more necessary.

During Sprints 2 and 3 the WIP limits appeared to be fair and no bottlenecks occurred. Nevertheless, it would be recommended not to stop experimenting with the WIP limit of the “Development” column, but to try with a slightly lower limit in order to see, whether it contributes to shorter lead time.

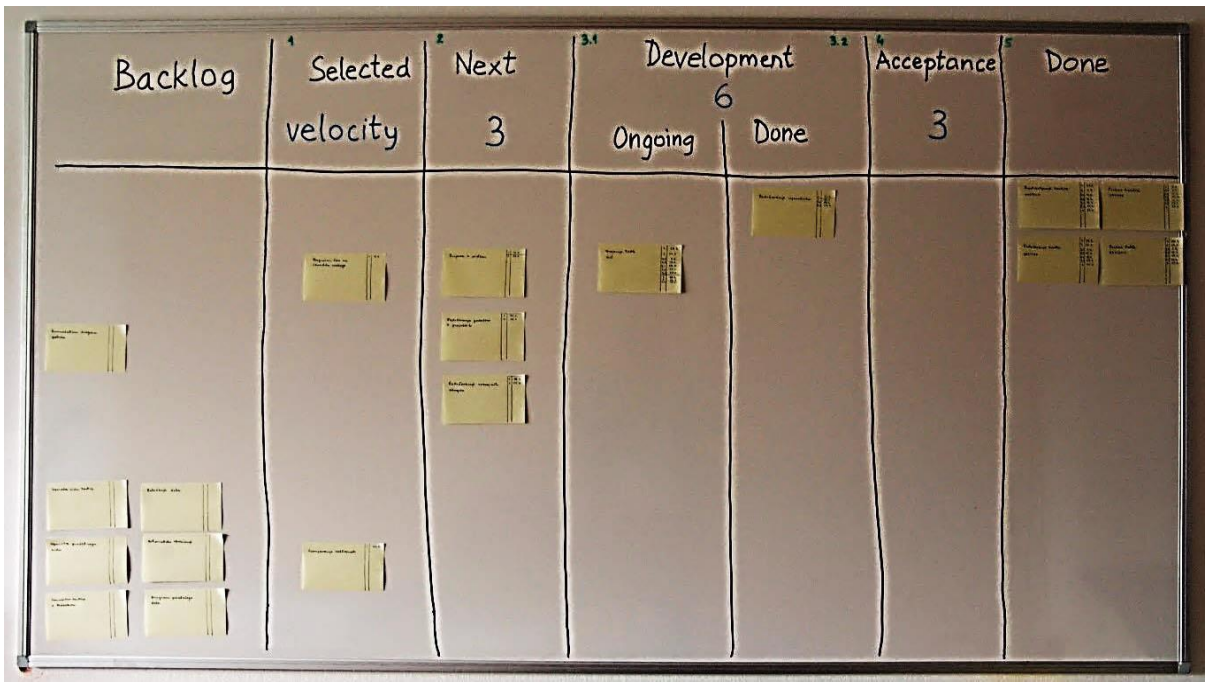

Figure 3 The Kanban board during Sprint 2

5. Conclusions

Kanban is a relatively new concept in software engineering; however, the early adopters report significant improvements in their development process. The purpose is to create a smooth flow through the system and minimize lead time by visualizing the workflow and limiting the WIP.

Kanban is empirical; therefore, it is expected that its users experiment with the process and customize it to their environment. In this paper, an experimental project that was conducted at the Faculty of Computer and Information Scienece, University of Ljubljana, Slovenia, is described. The project provided better insight into how Kanban principles work in

practice and helped to define appropriate structure of a Kanban board that can be used in combination with a Scrum-based software development process. Additionally, a web based tool for managing Kanban projects was developed that automatizes manipulations with user stories and visualizes their flow through the system on an electronic Kanban board.

We hope that our paper will contribute to better understanding of Kanban and help software engineering professionals who plan to introduce Kanban in their development process to find optimal way for implementation. From pedagogic point of view, the project revealed that students quickly grasp Kanban principles and their use in practice. Therefore, we decided to use this project as a basis for our capstone software engineering course next year.

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SOFTWARE DOCUMENTATION IN AGILE DEVELOPMENT PROCESS

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ABSTRACT

Agile development methodologies are designed for delivering viable products in short release cycles. However, a product is not complete without proper user documentation. If the product's functionality is not described in a way so that the target users of the product can fully utilize it, then the released product may not deliver the expected value to the Product Owner. This paper focuses on problems the writers of the technical documentation have to face when working in an agile development environment while trying to include the delivery of their part of the product within the iterative release cycles.

KEYWORDS

Documentation, technical writer, agile, Scrum, project management

1. Introduction

User documentation is a necessary part of almost every software development project. It ensures that people, who will use the developed product, will know how to put it to good use. Without a proper documentation, the product would not be complete.

In a traditional "waterfall" project management, the process of creating user documentation has its place defined. It starts right after the product is developed and finished. This is logical, as the technical writer can see the product as a whole, test its functionality, learn how it works and only then write the documentation for users.

With growing number of software companies introducing agile methodologies as their product management practice, though, the technical writers have to adapt to a completely new style of work. Creating user documentation in agile environment has its own specifics and rules and is also demanding to personal qualities of the technical writers. One of the main obstacles that has to be initially overcame is the question whether the software really needs the documentation. After all, the agile manifesto states that working software is valued more than comprehensive documentation. This, however, does not mean that the documentation should be left out completely. A precise and technically correct documentation must still be part of the delivered product. Another issue is getting used to short release cycles and publishing or presenting a working documentation frequently.

2. Environment

If a technical writer is supposed to work in an agile environment effectively and without stress, then it must be ensured that certain practices are in place. One of them is functioning agile development itself. For example, if Scrum is implemented, then the prerequisite is that the work is divided between teams of cross-functional people and that the team sits together and closely collaborates. There are also enough Scrum masters to ensure adherence to the process, capable Product Owners to define the priorities of tasks and everyone knows their roles. Of course, the implementation does not have to be perfect for the documentation to be created in an agile way, but the process has to be working in some way.

2.1 Communication

The technical writer's main weapon in agile environment is communication. Talking to the team members and asking questions about the functionality should be encouraged and made as easy as possible. Therefore it is recommended that the technical writer sits together with the team and attends all essential team meetings (Daily meetings, Spring planning, grooming and retrospectives). This way, the technical writer is part of the whole development process and can also contribute in the development by helping with the user interface (the technical writer partially represents the user), designing error messages and checking the text strings.

2.2 Personas

Not only do the developers need to know who will be using their software, it is also critical for the technical writers to imagine their readers. For this purpose, every software project should have its own set of personas, which are made up profiles of people representing the most typical users of the product. It is a good practice to create whole personalities with their own history, background and hobbies, to better illustrate the type of the person. Defining personas is important in every type of software development, but it is essential in agile. Knowing the users helps technical writers define the style and technical level of the documentation and allows them to focus on the most useful topics for them. Personas also represent building blocks for defining user stories.

2.3 User stories

The functionality to be implemented should be defined in the form of user stories. These are created by Product Owners (who represent the customers) or the developers themselves. A user story is a short written text, which describes a requirement for the system, includes the type of person who requires it and optionally specifies the reasons for the requirement. The form of user stories typically follows a simple template: As <persona>, I want <goal>, so that <reason or value>.

For example, "As Stacy (content editor), I want to add new fields to an on-line form so that I do not have to ask the website administrator to do that for me."

The user stories can also include acceptance criteria, which are used to verify when and how the user story is completed, and which can be defined for example using test cases. These practices also significantly help technical writers understand the functionality before it is even implemented.

2.4 Documentation tool

It is important to choose the right software tool for creating and maintaining the documentation, which would suit the agile process. The tool should support collaboration, so that multiple technical writers can work simultaneously and access each other's documents. It should also support versioning and tracking of changes to facilitate the maintenance of documents. Another important feature of a good agile documentation tool is the ability to allow for user contributions, be they in the form of comments or whole articles. This helps the technical writers stay close to the users and react to product changes more quickly.

One of the types of documentation tools that satisfy these conditions are wikis. These provide ideal conditions for creating agile documentation, because they are easy to use, they support collaboration, versioning and tracking of changes and eliminate the necessity of uploading documents, as the pages are published immediately after saving. Communicating

with users is also not a problem on wikis. They can be allowed to add comments, whole pages or contribute to forums.

3. Agile documentation and its problems

So the technical writer is part of the team, alongside the developers and QA engineers, attends meetings, participates in the development process and has knowledge about the product from the beginning of specifying its requirements (user stories). When should be the best time to start creating the user documentation? The technical writer could lag one cycle and create the documentation after the functionality is implemented. This approach is logical, but it is not actually agile. The team would not deliver a complete functionality in one release cycle, because the documentation is part of the product and has to be delivered with it.

If the technical writer wanted to document a complete functionality within the same release cycle after the development is finished, it would bring many difficulties. Apart from development and testing estimates, the user stories would also need documentation estimates to add enough time within the cycle for documentation after the development is done. This would put great pressure on technical writers at the end of each cycle and provide ground for hasty finalization works from the developers' and QA engineers' side.

Another solution is to start writing the documentation at the beginning of the cycle, even before the development is initiated. Many people think that this is a waste of time or that this technique cannot produce quality documentation, but the opposite is true. Creating the documentation without seeing the product is possible because of thoroughly written user stories, which provide the technical writer with enough information to begin with. Moreover, the user stories represent the most often performed actions in the system, which should therefore be documented using the task oriented style of writing. This way, the technical writer has enough time to document the basic tasks during the development phase and then finalize the documentation (add names of the UI elements, create screenshots, perform proofreading, etc.) during the testing phase. The developers should also review the documentation at the end of the cycle to correct any technical imperfections but, when using this method, the scope of the document is usually quite small and easy to read for them. The most difficult part of this method is for the technical writers to get used to writing fiction.

4. Conclusion

The integration of technical writers into the agile development process is possible and can be beneficial for all participants. If the members of the development process adhere to the agile principles and if the right tools are chosen, then the technical writers can thrive in this environment and create precise and useful documentation, which would accompany every released functionality. Being part of a team may be difficult for technical writers at first, as it requires daily collaboration and communication with a group of technically oriented experts. Attending to all the team meetings can be exhausting and switching from writing exact instructions to writing drafts of instructions requires getting used to. But this all leads to a well written and correctly targeted documentation in a timely manner.

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FRAMEWORK OF PROCESS MODEL OF PROCESSING UNSTRUCTURED DATA FOR DECISION SUPPORT

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ABSTRACT

Most of the data stored on the Internet in the form of unstructured text, which must be converted into a clear and unified user experience. This paper describes the basic characteristics of the stages of the framework process model unstructured data. Post a view of the possibility of processing data that are available on the Internet under the Framework process model. Furthermore paper discusses the possibility of using this approach in the area of small and medium-sized enterprises.

KEYWORDS

SME's - small and medium-sized enterprises, process, data source, Customer Intelligence, ontodology

1 Úvod

V podnikové praxi existuje celá řada aplikačního software, které podporuje řízení vztahů podniku s externími, hlavně obchodními partnery. Tyto systémy jsou zpravidla označovány jako PRM (Partner Relationship Management), někdy jsou také nazývány jako systémy Customer Intelligence (CI). Činnost CI lze také chápat jako nepřetržitý, etický proces získávání a vyhodnocování dat, informací a znalostí z okolí firmy za účelem dosažení lepší pozice na trhu [7] [16]. Systémy se primárně orientují na shromažďování a analýzy dat zejména z následujících vnitrofiremních datových zdrojů, které mají stálou strukturu dat, jako jsou např.:

- záznamy z interakcí se zákazníkem;
- záznamy obchodních kontaktů;
- dokumentace z obchodních center;
- data e-Business aplikací;
- ostatní databáze podnikového ERP apod.

Mezi externí datové zdroje CI pak náleží především data dostupná na Internetu[1] [2], která jsou především uložena na:

- speciálních veřejných portálech;
- podnikových portálech;
- sociálních sítích, blogs a internetových diskusích;
- sociální elektronická media (e-magazines, e-zones. atd.);
- e-mailové zprávy apod.

Nevýhodou zpracování dat, jejichž zdrojem je Internet, je skutečnost, že mají většinou nestrukturovaný formát. Ale právě tato dat většinou přinášejí firmám specifické možnosti,

jejichž využitím mohou tyto firmy získat i významnou konkurenční výhodu [4]. Mezi tyto požadované vlastnosti CI především patří získání aktuálních podrobných informací o:

- obchodních partnerech a zákaznících;
- konkurenci s cílem zvýšení úspěšnosti vlastního prodeje;
- potenciálních zaměstnancích.

Zpracování internetových datových zdrojů a jejich využití lze rozdělit do dvou základních oblastí.

a) Zpracování internetových dat s poměrně stálou strukturou, která jsou uložena na speciálních veřejných portálech.

b) Zpracování nestrukturovaných textů, které představují sice doplňující zdroj informací, které ale mohou významných způsobem ovlivnit především úspěch obchodní činnosti firmy [1].

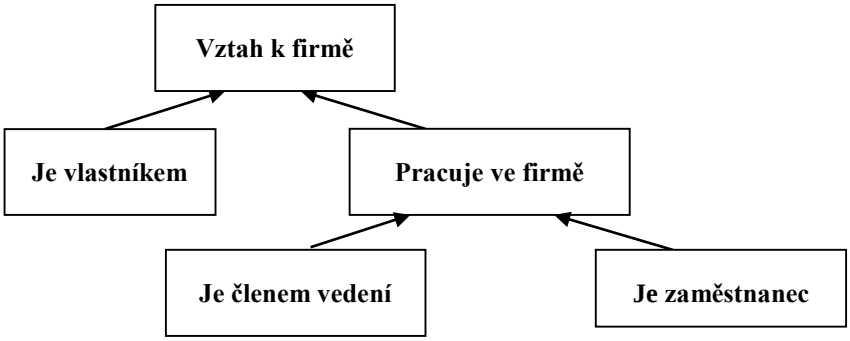
2 Charakteristiky zpracování nestrukturovaných dat

Ve velké většině případů malé a střední firmy potřebují informace o potenciálních obchodních partnerech, případně potřebují informace o své konkurenci, respektive o klíčových zaměstnancích konkurenční firmy [6]. Případně firma potřebuje také informace o osobách, které se u ní ucházejí o zaměstnání. Tyto informace mohou získat dvěma způsoby:

- Zprostředkovaně (jednorázově nebo opakovaně) jako službu speciálních SW firem. Tento způsob však vykazuje jisté časové zpoždění a nemalé náklady. Například si lze objednat data o firmách jejich insolvenci apod. ve formě souborů, které jsou platné k určitému datu.
- Přímo (nepřetržitě) jako službu komponenty CI podnikového informačního systému. Klíčovým problémem je zde identifikace relevantních datových zdrojů na Internetu.

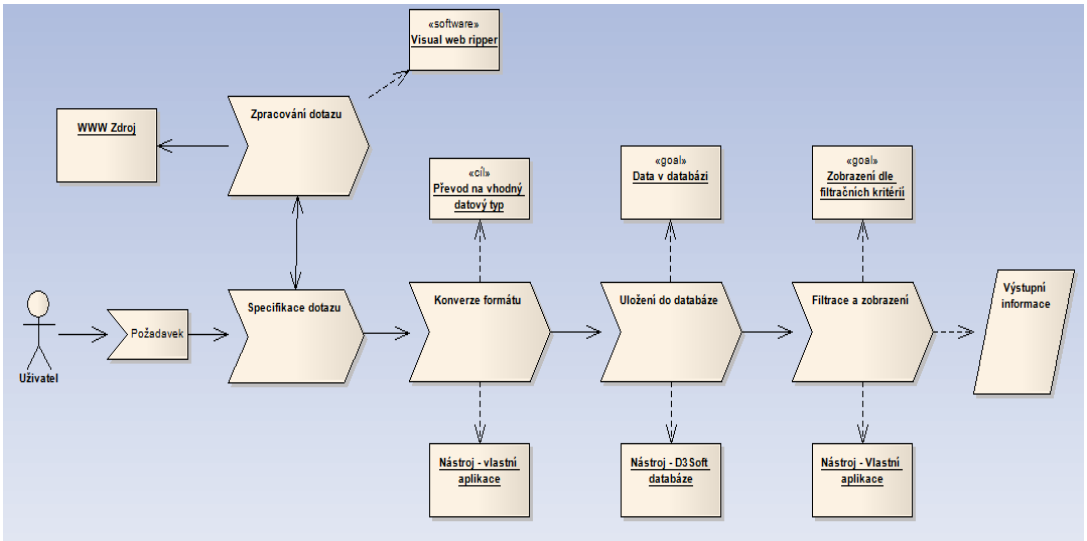
2.1 Zpracování internetových datových zdrojů s poměrně stálou datovou strukturou

Internetové datové zdroje poskytují aktuální informace o firmě jako: Název, IČO, DIČ, sídlo (Ulice, PSČ, Město), apod. Nevýhodou těchto datových zdrojů je poměrná nestálost struktury webových stránek a nestandardní popis jednotlivých zobrazovaných údajů. Tato skutečnost vyžaduje monitorování struktury vybraných datových zdrojů a následnou aktualizaci údajů uložených v RDF (Resource Description Framework), který představuje popis jak metadat, tak i postupy práce s nimi. Pro složitější vyhledávání je nutné použít Web Ontology Language (WOL), který rozšiřuje možnosti RDF v oblasti tvorby ontologických struktur [9] , jak uvedeno například na obr. č. 1.



Obrázek 1 Ontologický model vyjádření vztahu k firmě; Zdroj: (vlastní)

Příklad procesu celkového zpracování internetových zdrojů s poměrně stálou strukturou dat je znázorněn na následujícím obrázku č. 2.



Obrázek 2 Proces zpracování internetových zdrojů s poměrně stálou strukturou dat; Zdroj: (vlastní)

Struktura popisovaného programového řešení vychází z definice jednotlivých webových zdrojů informací pomocí objektových tříd, které jsou blíže specifikovány pro konkrétní nástroj stahování dat z Internetu. Výhodou tohoto typu zpracování je získání aktuálních požadovaných informací z prověřených zdrojů v požadované a srozumitelné formě zobrazení.

2.2 Zpracování datově nestrukturovaných internetových datových zdrojů

Převážná část dat uložených na Internetu je v podobě nestrukturovaných textů, které je nutné konvertovat do přehledného a jednotného uživatelského prostředí. Celý tento proces lze rozdělit do následujících 4 fází [8] (obr. č. 3):

- monitorování a shromažďování zdrojových dat;
- správa a ukládání zdrojových dat;
- zpracování dat analytickými nástroji;
- prezentace výsledků analýzy.

Obrázek 3 Proces zpracování nestrukturovaných dat internetových zdrojů; Zdroj: (vlastní)

Při procesu zpracování nestrukturovaných dat pro výše definované potřeby je nejdříve třeba určit cíl monitoringu na Internetu. Dále je nutné zajistit přístup do určených sociálních sítí a diskusních fór. Zde je třeba postupovat v souladu s platnou legislativou příslušného státu, např. nevydávat se za někoho jiného apod. Vybrané cíle jsou pak na Internetu sledovány a v případě, že vyhledavač najde nějaké „zajímavé“ informace o daném cíli, pak je uloží na lokání server do inteligentní databáze, která umožňuje především rychlé vyhledávání

a indexaci dat. Tato data jsou následovně analyzována a výsledky analýzy jsou reportovány koncovému uživateli.

2.3 Monitorování a shromažďování dat

Existuje mnoho metod získávání nestrukturovaných dat z Internetu, protože zvolený přístup musí respektovat specifické vlastnosti každého individuálního zdroje. V zásadě lze tyto přístupy rozdělit do dvou základních skupin.

- Techniky orientované na sociální sítě.
- Techniky orientované na ostatní zdroje (např. reklamy, diskuse apod.). Pro potřeby CI lze postupovat tak, že se daná složka reklamy nebo diskuse stáhne úplně na podnikový server.

Existuje velké množství softwarových nástrojů, které tyto službu poskytují. Obecně jsou tyto nástroje nazvány jako „web roboti“. V případech internetových diskusí je někdy nutné uložit webovou stránku pomocí plug-in jako obraz a následně ji převést do textové podoby pomocí OCR. V případě získávání dat ze sociálních sítí nelze web roboty uplatnit, zde je nutné získat požadovaná data pomocí speciální plug-in, které automaticky procházení veřejnou (případně soukromou) částí sociální sítě, kterým má daný plug-in nastaven uživatelský profil.

2.4 Správa a ukládání zdrojových dat

Pokud jsou získaná data z Internetu příliš rozsáhlá, pak by neměla být uložena v konvenčních relačních databázích. S nárůstem využití CI je nutné využít k tomuto účelu vyhrazené servery, jejichž součástí je specializovaný jazyk, který slouží k manipulaci s tímto typem dat. Z důvodu zajištění lepší rozšiřitelnosti a variability, také nabízí možnost využití technologie cloud comutingu pro ukládání velkých objemů dat a manipulaci s nimi [3]. Výhodou použití těchto nástrojů je jejich využitelná kapacita, rychlost a schopnosti indexování nestrukturovaných dat. Navíc tyto nástroje poskytují možnost počátečního filtrování dat před provedením vlastní analýzy těchto dat. To znamená, že inteligentní databáze, které mají v sobě zaintegrovány funkce zpracování dat, umožňují vytvořit výběry dat, nad kterými lze efektivně aplikovat specializované analytické algoritmy (např. techniky data-miningu).

2.5 Zpracování analytickými nástroji

Na úrovni databáze vybraných textů se pracuje obvykle s analytickými funkcemi, které přetřiďují data podle času, zdroje, typu apod. Na této úrovni zpracování nestrukturovaných textů lze využít i analytické funkce, jako je filtrování zvoleného slova nebo jméno osoby. Tyto operace se obvykle provádějí v pozdějších etapách zpracování pomocí speciálních softwarových nástrojů, které musí být kalibrovány podle doménových oblastí, což u nástrojů databázové úrovně není obvyklé [11]. Zpracování nestrukturovaných dat lze rozdělit do následujících oblastí:

- analýza obsahu;
- identifikace entity (analýzy autorství);
- analýza vztahů;
- analýza sentimentu.

2.5.1 Analýza obsahu

Sémantická analýzy patří k základním oblastem zpracování nestrukturovaných textů. Cílem je identifikovat, klíčové pojmy, které se v textu objeví. Při jejím provádění je ale třeba vyřešit několik problémů, jako jsou:

- v jakém jazyce je napsán text;
- jsou jednotlivé části textu již zpracovány pomocí slovníků a pravidel jazyka;
- překlepy a hovorové výrazy.

Následně jsou odděleny od textu slova nesoucí sémantické informace, tzn. kombinace vybraných podstatných a přídavných jmen, sloves a číslovek. Současně jsou synonyma, na základě kterých mají výrazy stejný význam, nahrazena jedním zvoleným zástupcem. Takto upravený text pak tvoří základ pro odvození témat jednotlivých textů, které mohou mít například formu seznamu klíčových slov. Celý proces analýzy obsahu se skládá z několika hlavních kroků, které jsou popsány v následujících odstavcích [5]:

- **Značkování slovních druhů** pomocí externích knihoven (např. POS Tagger). Z takto označených slov jsou vybrána slova klíčová, většinou podstatná jména, slovesa a přídavná jména. Tento proces musí být vysoce sofistikovaný, protože musí vzít v úvahu i kontext, ve kterém se dané slovo vyskytuje [12] [15].
- **Zpracování synonym** umožňuje sdružování jednotlivých na základě jejich významu a to nejen v závislosti na jejich formě, ale i s možností vytvořit vztahy mezi nimi. Při identifikaci synonym je nezbytné odstranit slova, které mají navzájem odlišný tvar, ale v podstatě stejný význam z výstupního seznamu klíčových slov [13]. Tyto případy mohou být rozlišeny pomocí slovníku lexikální databáze.
- **Lemmatizace a stemming** se pokouší převést do jeho základního tvaru. Lemmatizace je časově náročnější protože při zpracování vychází z kontextu daného slova. Stemming je nebere v úvahu kontext daného slova a proto je rychlejší. Pro kvalitní výsledek zpracováno obsahu textu je nutné provedení lemmatizace nebo stemmingu, protože slova vyskytující se v různých tvarech musí být rozpoznána jako identická. Pak lze ekvivalentní slova přiřadit k sobě a tak se vyhnout roztroušenosti klíčových slov [14].

2.5.2 Identifikace entity

Identifikace osob, které vytvářejí příspěvky na internetu, případně jsou uvedeny v obsahu těchto příspěvků, je obecně složitá, protože tyto osoby uvádějí svou identitu pomocí různých pseudonymů a často jednají zcela anonymně. Za těchto podmínek je velmi důležité si uvědomit, že více identit představuje stejnou osobu. Rozpoznat to lze například na základě stejného telefonního čísla nebo e-mailu, ale ve většině případů se tato informace není k dispozici. Další technika používaná k identifikaci stejné osoby, je analýza jejich psaných textů, kdy na základě podobnosti slovní zásoby, častého výskytu vybraných slovní spojení, stejné pravopisné a typografické chyby, jako jsou překlepy, lze odvodit pravděpodobnost, že text byl napsán stejnou osobou.

2.5.3 Analýza vztahů

Tato etapa představuje způsob identifikace osob a rozpoznání vztahů mezi nimi. Výsledkem je vnitřní „sociální“ síť, která je vytvořena na základě souvislostí k ostatním osobám, se kterými jsou na základě získaných dat v nějakém vztahu [2]. Vztahy mezi osobami dále se dále klasifikují podle typu vztahu a jeho intenzity. Čas je zaznamenán jako

samostatný parametr se všemi těmito daty, což pak umožňuje vidět vývoj daného vztahu k osobě, nebo jakým způsobem se vyvíjely vztahy mezi skupinou osob. Na základě takto zjištěných údajů lze osoby rozdělit do skupin nebo poskytovat metriky indikující blízkost jednotlivců [10].

2.5.4 Analýza sentimentu

Tato etapa je prováděna pomocí speciálního software, který hledá konkrétní slovní spojení, které označuje typ a stupeň sentimentu v doménové oblasti. Software vytvořený pro rozpoznání sentimentu lze rozdělit do dvou částí:

- tvorba a kalibrace databáze znalostí;
- hodnocení sentimentu.

Obě části jsou na sobě nezávislé. Úkolem znalostní databáze je naučit systém rozpoznat typ sentimentu v dané doménové oblasti. Funkce pro hodnocení sentimentu používá příslušnou část znalostí a vypočítává sentiment neznámých textů. Tato funkce může být začleněna přímo do informačních systémů společnosti, nebo to může být využívána jako webová služba [4].

2.5.5 Prezentace výsledků analýzy

Výsledky analýz jsou prezentovány ve třech základních formách:

- detailu nalezeného záznamu;
- graf, který slouží především k vizualizaci vývoje jevu v čase (čarové a sloupcové grafy grafy), vizualizaci procenta různých typů subjektů (koláčové grafy), nebo pro vizualizaci vztahů (síťové diagramy, n-úhelníky).;
- kombinací grafů, tj. speciálním typem vizualizace jako je spektrograf, který je často využíván v kombinací s Liferay.

3 Charakteristiky implementace procesního rámce

Při implementaci rozšíření CI v SME's je nutné přihlížet k účelu budoucího využití takového modulu. Většina stávajících uživatelů v tomto segmentu v praxi nevyužije všechny možnosti, které jsou uvedeny výše a zároveň podle zkušeností autorů tohoto příspěvku neví, jaký druh informací přesně požaduje a v jaké formě by jej rada obdržela. Proto je třeba velmi uváženě usměrňovat někdy nereálné představy uživatelů, že internetu je opravdu všechno co by chtěli vědět veřejně dostupné a zároveň je seznámit s náklady na zjištění takové informace. Z těchto důvodů se doporučuje velmi přesně identifikovat doménové oblasti a typ informačních zdrojů na internetu.

Zpracování nestrukturovaných dat z internetu sice poskytuje možnost získat více „specifických" informací o dané entitě, ale je třeba uvážit, že každé takové řešení je ve své podstatě jedinečné a proto zatím i nákladné. V segmentu SME's většina uživatelů požaduje standardní informace o obchodním partneru nebo zákaznícovi. Velmi zřídka pak tito zákazníci chtějí zpracování v oblasti analýzy sentimentu, protože jsou většinou v přímém kontaktu se svými zákazníky a znají jejich názor.

Dále je třeba přihlédnou k technologickým možnostem daných firem a z tohoto důvodu bude asi vývoj těchto aplikací směřovat k využití platformy cloud computingu.

4 Závěr

Zpracování nestrukturovaných dat z internetu může přinést firmám konkurenční výhodu. Pro nasazení v malých a středních firmách je důležité určit účel zpracování takových dat. Rozhodující pro nasazení CI je ovšem cena připravovaných aplikací, protože v současné době nejsou na trhu typová řešení. Pokud se jedná o požadavky na standardní informace, je možné využívat analýzu off-line předzpracovaných dat a vybrat si z nabídek společností zpracovávající data o ekonomických subjektech na tuzemském trhu. Řešení stavěná na klíč by při složitějších požadavcích na objem i strukturu zpracovávaných informací představovala velké finanční zatížení. Proto předpokládáme, že jej ve většině případů nebudou zatím v dohledné době firmy v rámci SME's využívat. Objevuje se tak významný potenciál českého trhu ve dvou dimenzích, což znamená připravit typové řešení s možností jeho customizace pro konkrétního zákazníka a dále nabídnout také řešení např. na platformě SaaS v podmínkách cloud computingu.

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USING TAG CLOUDS TO VISUALIZE TEMPORAL ASPECT OF DATA

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ABSTRACT

In this paper we would like to present results of our research focused on using tag clouds to visualize the changes in data over time. Tag clouds can be used to present most important keywords in particular domain. The appearance and importance of particular keywords can change over time. On the tag cloud it can be mark through visual modification of the tag. We can change the color or the shape of tag to show its importance in particular moment in time.

KEYWORDS:

Tag clouds, text mining, visualization, keywords

1 Introduction

Tag clouds are very useful tool for data visualization. They can be used to present most important keywords in particular domain.

In this paper we would like to present results of our research focused on using tag clouds to visualize changes in data over time. The appearance and importance of particular keywords can change in the long run. On the tag cloud it can be mark through visual modification of the tag. We can change the color or the shape of tag to show its importance in particular moments in time. However it is important to remember about the clarity of clouds.

2 Keywords in abstracts of scientific papers

Keyword (index term, subject term, subject heading, or descriptor) in information retrieval, is a term that captures the essence of the topic of a document1. Index terms can consist of a word, phrase, or alphanumerical term.

In most of scientific magazines or journals authors are asked to point out few keywords of the paper. On this basis editors can identify the best revivers who specializes in particular area. During conferences keywords can be used to schedule presentation in suitable session. On the basis of keywords a lot of conclusions concerning particular domain of knowledge can be inferred.

Not always we have keywords given by the author. They can be identified by analyzing the document either manually or automatically with different methods of keyword extraction. The text-mining methods of keywords identification can be divided into few groups (Gładysz, 2013):

- methods based on frequency matrix
- methods based on SVD decomposition
- methods using results of luster analysis

1 http://en.wikipedia.org/wiki/Index_term

- methods based on LDA method
- methods based on supervised learning –KEA algorithm
- graph methods –RAKE algorithm
- clouds of tags

As it can be seen tag clouds are one of the methods used for keywords extraction.

3 Tag clouds

A tag cloud (or word cloud) is a visual representation for text data, typically used to depict keyword metadata (tags) on websites, or to visualize free form text2. It can be treated as visual summary of document content (Lee, et al., 2010).

Tags are usually single words, and the importance of each tag is shown with font size or color. More frequently word appears in the document (or on web site) more important it is. Tag clouds are very popular on personal or commercial web pages, blogs and social information sharing sites (Hearst, et al., 2008). Since they became so popular and commonly used there are a lot of web services offering tag clouds creation applications. They can work on different input data types (such as file, website, plain text etc.). Tag clouds can have different shapes and colors. Also various fonts can be used.

Figure 6. Examples of tag clouds. Source: own elaboration in tugxedo.com

Figure 6 above presents exemplary tag clouds created in one of free tools available in the internet. All of them were prepared on the basis of the same data source.

4 Visualization of temporal aspect of data using tag clouds

Tag clouds can evolve as the associated data sources change over time (Lee, et al., 2010). However classic tag cloud presents the visualization of data source in particular moment of time. When there is a change in data new cloud is created.

There is a few of papers concerning the problem of taking time dimension into account on cloud of tags. Most interesting propositions involve distortions of tag shape, transparency regulation or coloring the background of tag in different tones reflecting tag frequency in particular moment of time (Nguyen, et al., 2011).

The two other approaches that include time related information on tag clouds are tagline and tag clouds containing line charts for each tag (Lee, et al., 2010). In our research we decided to test second of them. However we made some examples using tagline.

Tagline is a sequence of tag clouds that are associated with time. It is created from a collection of documents. Each document must be assigned to particular time period. Dynamic

2 http://en.wikipedia.org/wiki/Tag_cloud

slider allows navigating through tag clouds generated for different (subsequent) time periods. Only one tag at time can be displayed.

Figure 7 presents sample of Tagline Generator capabilities. Example concerns two consecutive years.

Figure 7. Two consecutive tag clouds; Source: own elaboration in Tagline Generator, http://chir.ag/projects/tagline

5 Empirical studies

The main part of the work is devoted to our proposition of taking time dimension into account on cloud of tags. It bases on tag clouds containing line charts for each tag.

4.1 Data source

In our research we used collection of paper abstracts concerning Management Information Systems (MIS). About half of abstracts used in research had predefined keywords attached.

Collection includes 2360 abstracts from 5 leading journals in MIS area:

- European Journal of Information Systems (since 1992),
- Information Systems Journal (since 1991),
- Information Systems Research (since 1990),
- Journal of Information Technology (since 1986),
- MIS Quarterly (since 1977).

We obtained the collection in XML format. It was used in (Grabowski, 2011) for series of research. Figure 8 presents exemplary abstract in its initial form. The first step was to convert .xml file to data base. In this database except some description data original keywords and keywords extracted from abstracts were stored.

To extract keywords RapidMiner application was used. The words from stop list were removed. Remaining words were stemmed and then all synonyms were replaced using WordNet. From this set only nouns were selected to database as keywords. All keywords were one-word. It was very simple and imprecise method, but gave interesting results.

Figure 9 presents chart characterizing collection used in research. On this figure we can see number of abstracts per decade. We can also read number of original and extracted keywords per abstract per decade.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/css" href="script/paper.css"?>
<paper xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="script/paper.xsd">
<id>
<journal>Information Systems Research</journal>
<year>1998</year>
<issue>4</issue>
<item>2</item>
<volume>9</volume>
</id>
<title>Globalization and Increasing Returns: Implications for the U.S. Computer Industry</title>
<authors>
<ali>Kraemer, Kenneth L.</ali>
<ali>Dedrick, Jason</ali>
</authors>
<keywords>
<kli>Increasing and Decreasing Returns</kli>
<kli>Globalization</kli>
<kli>Computer Industry</kli>
<kli>Industrial Policy</kli>
<kli>Industry Structure</kli>
<kli>Competition</kli>
<kli>Asia-Pacific Region</kli>
</keywords>
<abstract>Over the last twenty years, the computer industry has become global with respect to computer production as well as
computer use, a trend which has raised concerns among U.S. policymakers of hollowing out the industry and exporting employment.
This paper uses the framework of increasing returns to analyze the issue. It classifies market segments within the computer
industry, shows how the advent of the personal computer created these segments, examines how this change in the structure of the
industry led to the evolution of an Asia-Pacific production network, identifies company and country leadership in this network,
and evaluates the implications for the United States. It shows that some manufacturing employment, mainly in the decreasing
returns segments of the industry, has shifted to the Asia- Pacific region. However, it also shows that employment in some
manufacturing segments and in software and services, which are increasing returns or hybrid markets, has increased dramatically
in the United States. It concludes that the global division of labor between the United States and both companies and countries
in the Asia-Pacific region has been largely positive in that it has supported the continuing U.S. leadership position in the
global computer industry.</abstract>
</paper>
```

Figure 8. Exemplary abstract in XML format; Source: own

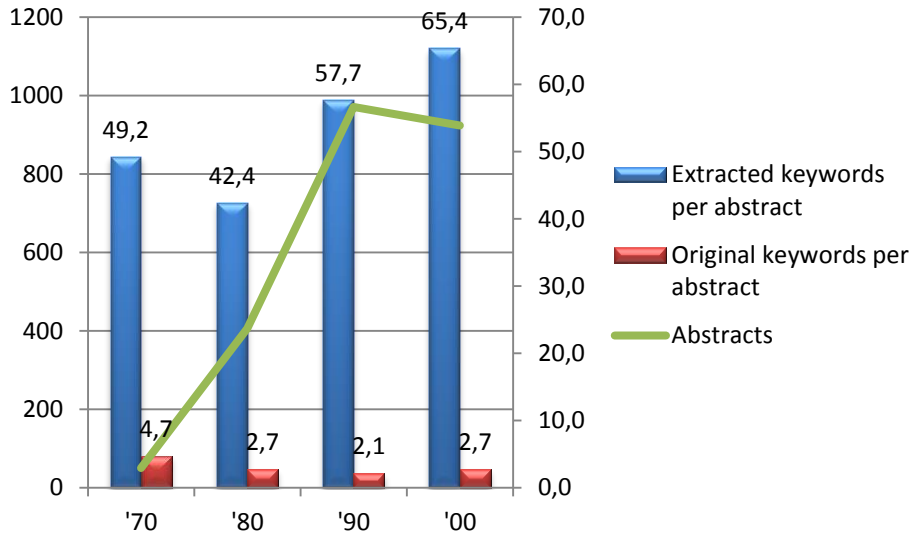

Figure 9. Statistics concerning abstracts used in research; Source: own elaboration

Next two figures also characterize set of abstracts used in research. Figure 10 presents characteristics of original keywords. There were not much of them (5407 words), but most were unique (3614 words what gives between 90% and 95% per decade).

On Figure 11 we can observe that there were much more extracted keywords (25716 words) but they were mostly not unique (only 4486 what gives 15% to 40% per decade).

This has one important consequence. On Figure 12 we have trend for 20 most frequent extracted keywords. The chart is difficult to read but not impossible. For original keywords creation of that kind of chart was possible but it has over 50 words and it was impossible to analyze it in any way.

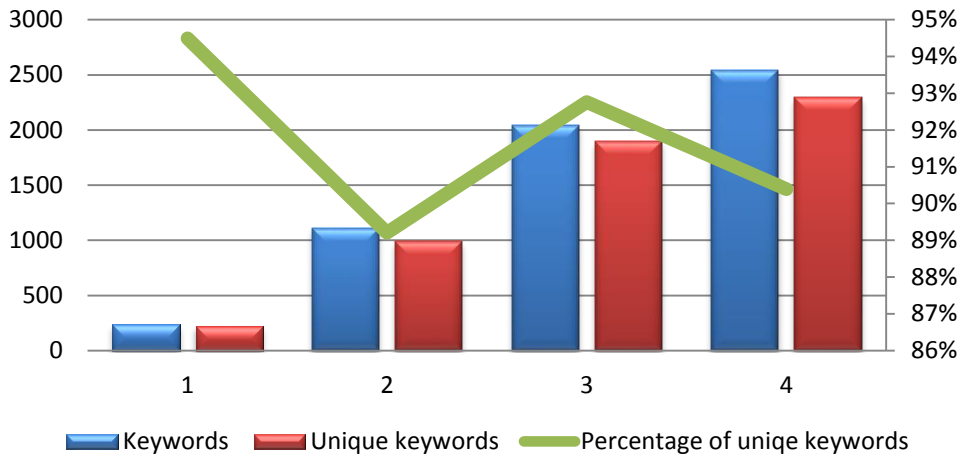

Figure 10. Original keywords used in research; Source: own elaboration

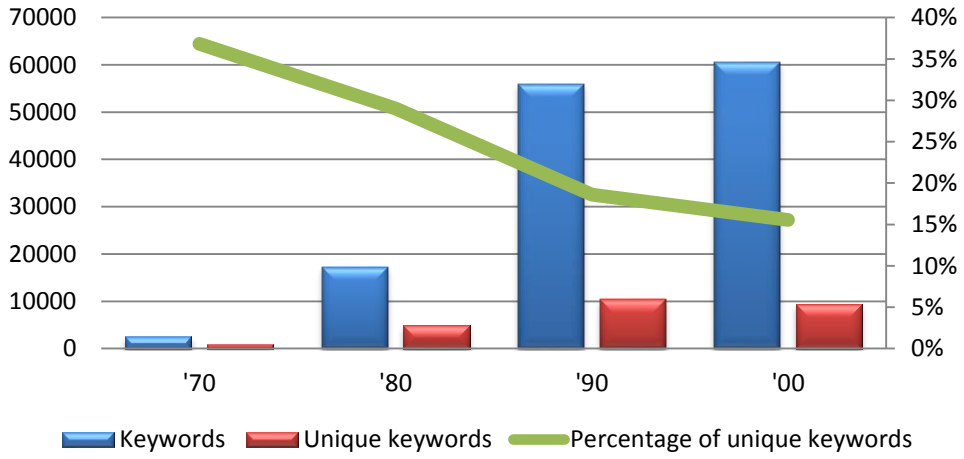

Figure 11. Extracted keywords used in research; Source: own elaboration

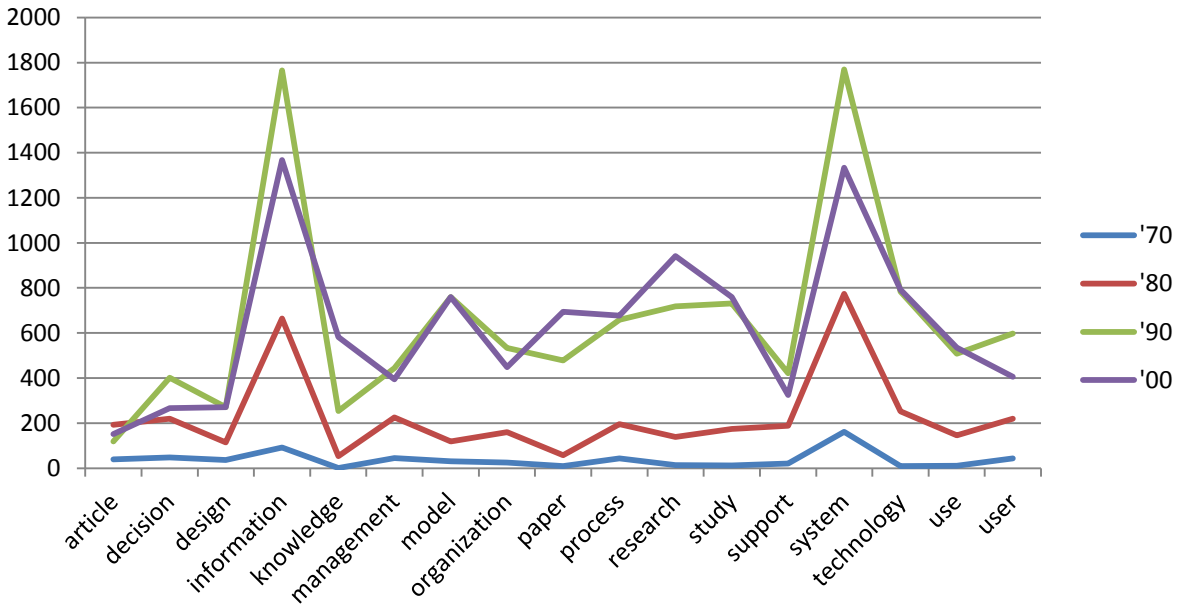

Figure 12. 20 most frequent extracted keywords through decades; Source: own elaboration

4.2 Experiment

When all data were imported to database, the cloud creation began. We invented web-based visualization application that generates cloud of tags. The font size reflects general term frequency while line char in background presents this term frequency in particular period of time. Figure 13 presents sample of created cloud.

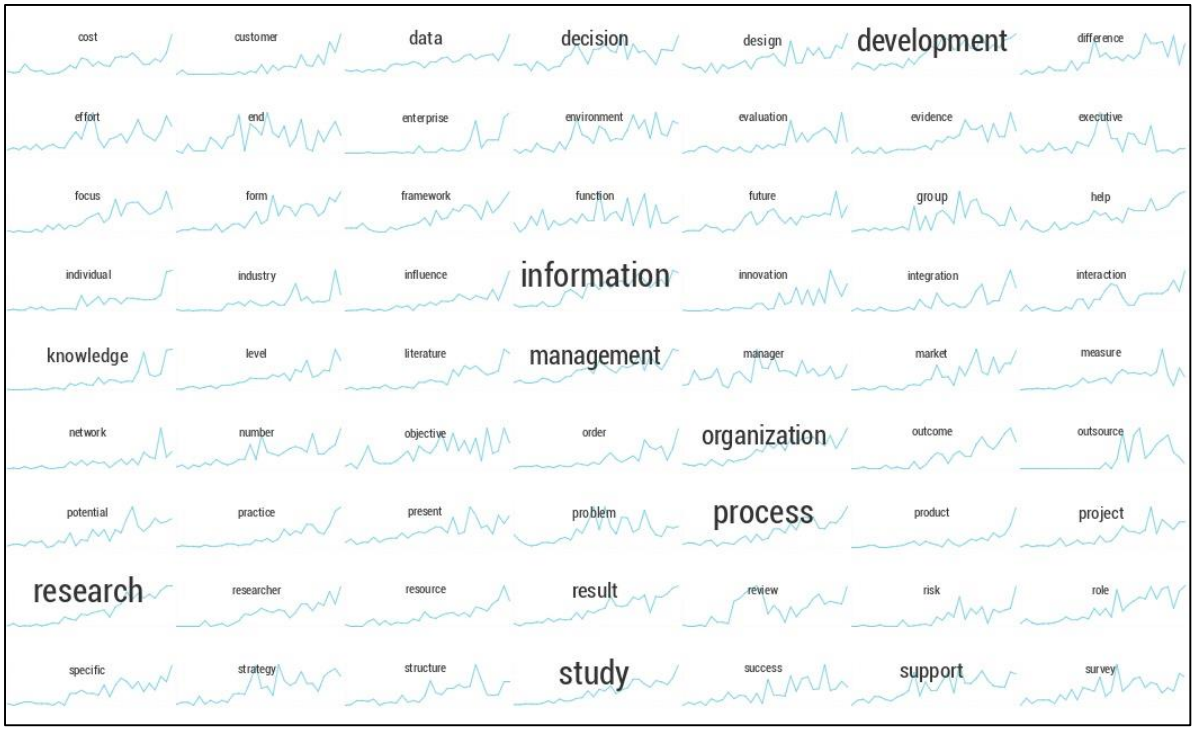

Figure 13. Cloud of tags; Source: own elaboration

We decided to move one step forward and every tag in the cloud is a link to bigger line chart. On this charts we can investigate usage of particular words in 5 journals over time. Figure 14 presents trends for organization tag while Figure 15 presents chart for word internet.

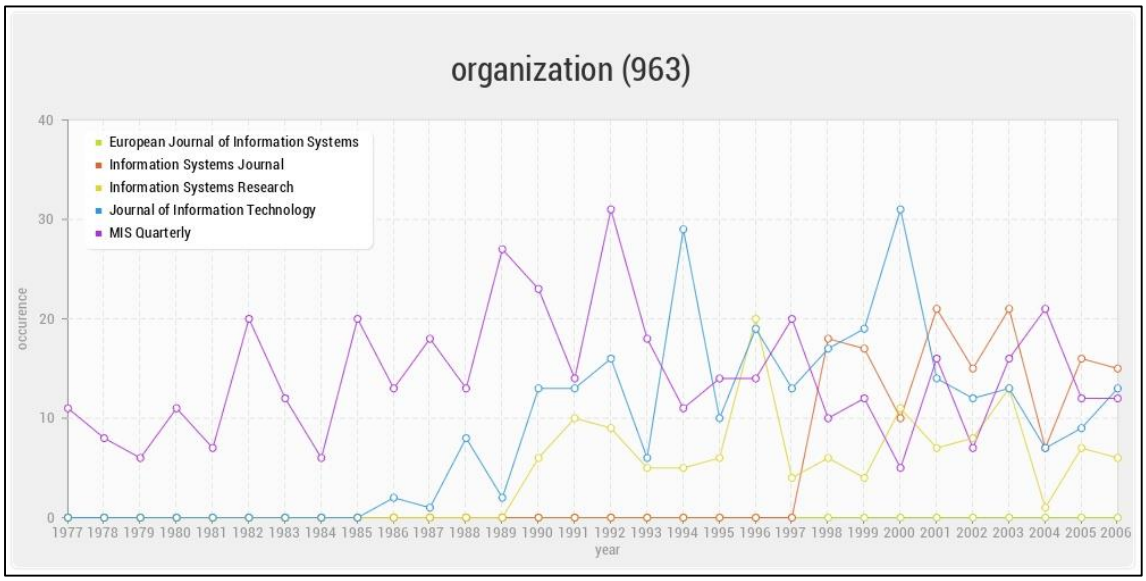

Figure 14. Single word frequency line chart (organization); Source: own elaboration

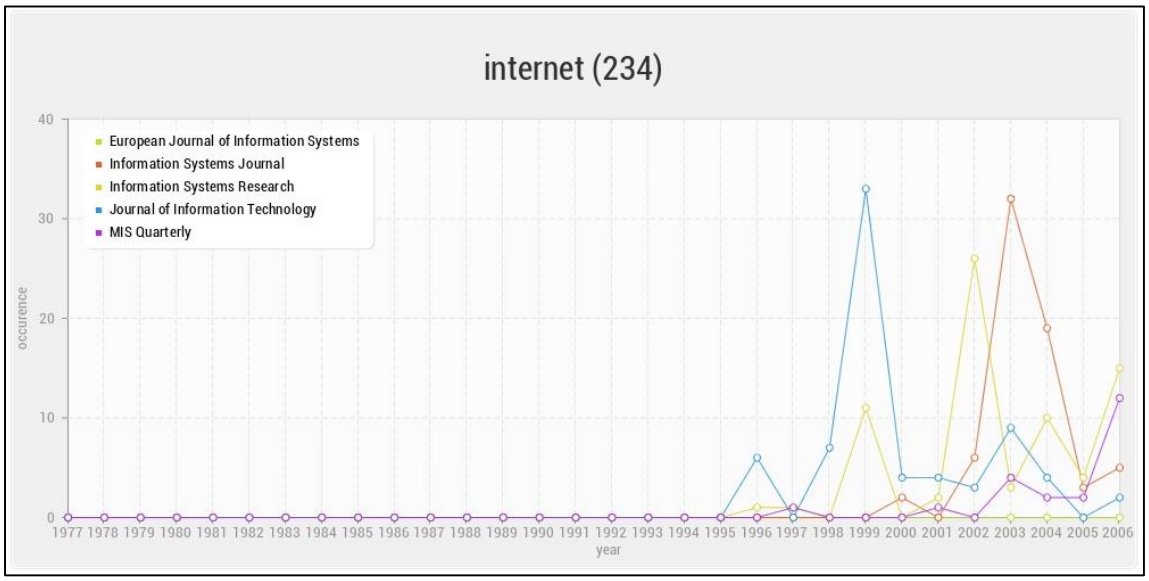

Figure 15. Single word frequency line chart (internet);

Source: own elaboration

5 Conclusions and further research

Results presented in this paper are only initial ones. There is still much to do in this area. However what we achieved ensures us that it is worthy do conduct further research in this area.

Next step would be to apply other ways of data presentation (color, size, font and position on the cloud). It is difficult when we want to keep the clarity of cloud so it could be easily analyzed. Also some animations can be used to enrich data analysis. Another similar topic would be to analyze relations between keywords.

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Information Society and Trends in the Education

APPLICATION OF THE ARDUINO PLATFORM IN THE EDUCATION OF PROGRAMMING

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ABSTRACT:
Arduino is an open development platform that consists of the open hardware based on the 8-bit Atmel AVR microcontroller and the open source multiplatform integrated development environment and libraries. This contribution focuses on our effort to develop a simple autonomous robot designed around the Arduino UNO board that would be used to support selected courses at Faculty of Nuclear Sciences and Physical Engineering.
At first, we introduce the Arduino platform and the Arduino UNO board. Then, the sensors and the actuators of the robot are described in more details: the robot uses infrared and ultrasound sensors to navigate itself in the environment. Arduino UNO works in perception – action cycles, it converts sensor data to instructions to the motor driver that controls caterpillar drives. Finally, we present our plans to utilize the robot in education of programming and algorithms of the artificial intelligence.

KEYWORDS
Arduino, micro-controller, robotics, education

1 Introduction

During the recent years, the Arduino platform quickly gains popularity in various fields including monitoring, control, electronics, robotics, or education. In this paper, a robot built on top of the Arduino platform is described. At first, hardware and software parts of the Arduino platform are briefly introduced, and then the Arduino UNO micro-controller is presented in details. We have used this micro-controller to develop an autonomous robot that acts as an intelligent agent. We describe sensors, actuators, and perception – action cycle of the robot. Finally, we discuss our plans to use the robot in education of programming and also we list the possible future upgrades of the robot.

2 Arduino platform

According to (4), the Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. Besides the hardware and software parts, the platform also includes the strong community of users that create documentation, share ideas, and create various Arduino project.

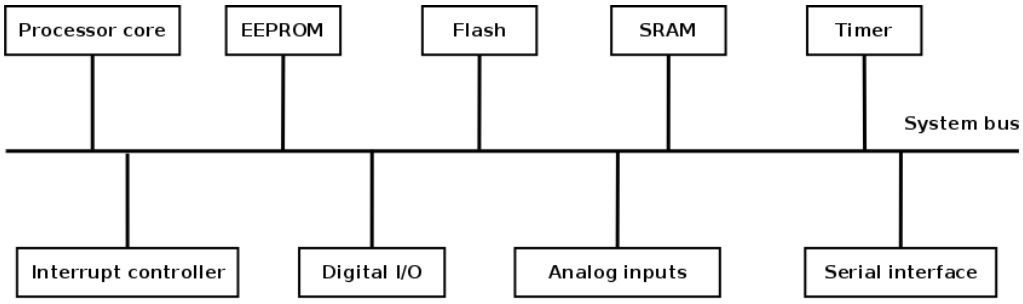

Figure 16: Structure of the micro-controller

The hardware part of the platform consists of family of micro-controller boards based on the Atmel AVR processor. Micro-controller is a monolithic integrated circuit that contains entire computer including processor, memory for programs and data, and peripherals such as digital pins, analog inputs and outputs, serial interface, timer or interrupt controller. All components communicate through the system bus.

In the following, we will focus on the Arduino UNO micro-controller that has been used in the robot. Arduino UNO is based around Atmel AtMega328 processor. The processor is supported by 32 kB of flash memory to store instructions (0.5 kB is used by the bootloader) and 2 kB of SRAM memory that can be used to store variables. Additionally, 1 kB of EEPROM is also available for user data; the EEPROM acts as a permanent storage (in contrast to SRAM which loses its contents every time the board is switched off). However, number of write cycles to the EEPROM is limited. Input and output is implemented in pins; there are 14 digital pins that can be programmed either as input or as output. Six of these pins also provide pulse width modulation (PWM). Pins 0 and 1 are used to receive (RX) and transmit (TX) serial data. Additionally, a light emitting diode (LED) is connected on pin 13. Arduino UNO operates on 5V, which can be provided by batteries, AC to DC convertor, or USB cable. The USB cable can also be used to exchange data with other devices, such as personal computer. Furthermore, the Arduino UNO board can be extended by shields (daughter boards) that extend its features; e.g. there are Ethernet, Wi-Fi, Bluetooth, or GSM shields available on the market, others can be developed manually.

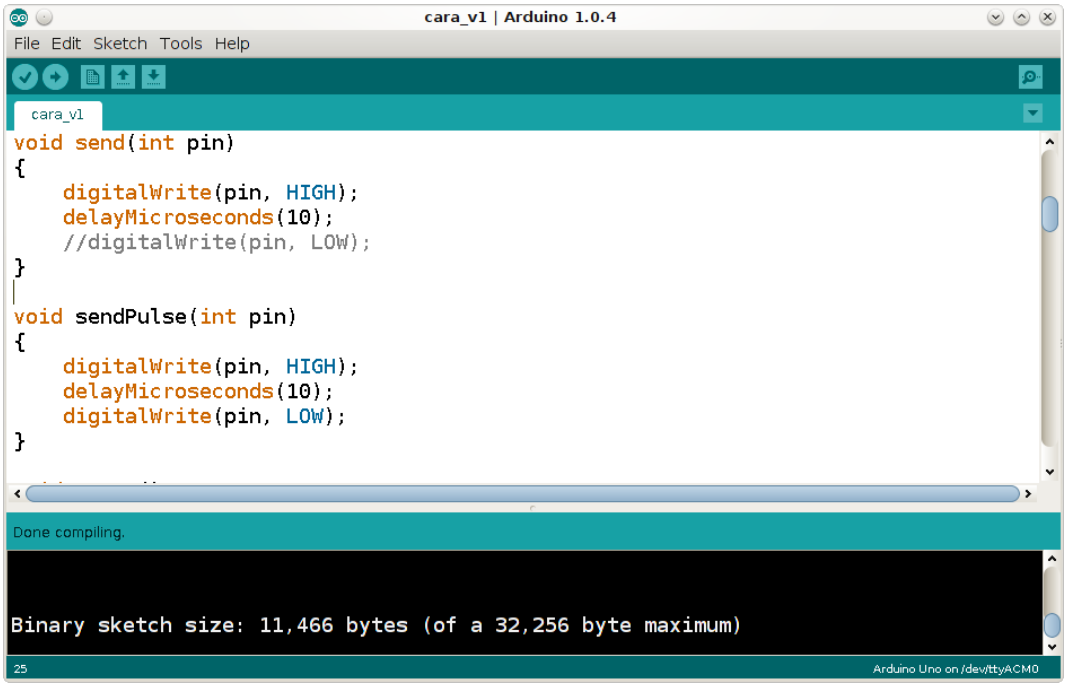

Figure 17: Arduino IDE

The software part of the Arduino project consists of the integrated development environment (IDE) called Arduino and the Wiring library that simplifies programming of input and output operations. The Arduino IDE is open source multiplatform application built on the Java platform; it runs in MS Windows, in GNU/Linux with X server, or under Mac OS. The code editor included in the Arduino IDE supports standard features such as automatic indentation, syntax highlighting, or bracket matching. The IDE allows to compile the code in the language similar to C++ to the binary form understandable by the Atmega328 processor

and upload the binary code into the Arduino through the serial over USB connection. The IDE contains the serial monitor than can be used to debug the communication over the serial line.

We will demonstrate the syntax of the language on a sample program (programs are denoted as sketches in the Arduino IDE) that turns the LED attached on pin 13 on a off. Each sketch contains at least two functions: setup and loop. The code in the setup function is executed only once when the Arduino board is booted or restarted. The function thus mainly serves for initialization of pins and variables. The code in the loop function implements the desired behavior, typically it transform data that are read from the input pins to data that are written on the output pins. Let us review the above mentioned sketch that toggles the state of the LED:

```
#define LED 13;

void setup()
{
  pinMode(LED, OUTPUT);
}

void loop()
{
  digitalWrite(LED, HIGH);
  delay(1000);
  digitalWrite(LED, LOW);
  delay(1000);
}
```

At first, the macro LED that contains the pin number is defined. In the setup function, the corresponding pin is configured as output via the pinMode function. In the main loop, the digitalWrite function is used to send either high or low voltage to the corresponding pin, thus switching the LED on or off. The delay function pauses the execution of code for given period of time.

The digitalWrite, pinMode, and delay functions are part of the Wiring library which also contains functions for reading values of pin, communication over the serial line, accessing the EEPROM memory, or working with interrupts. More details about function and syntax of the language can be looked up in the reference documentation (4).

Arduino based robot

Our aim was to develop an autonomous robot intended line tracking. We have decided to build the robot on the Arduino platform because of its openness, availability, and active user community. Furthermore, with price tag of about 25€, Arduino UNO is relatively cheap device.

The robot can be regarded as an example of the intelligent agent. In the artificial intelligence, an intelligent agent is an entity that interacts with its environment through sensors and actuators (2). Intelligent agent uses its sensors to sense various properties of the environment and maps these values to the actuators that perform actions on the environment. The agent works in the perception—action cycles. Intelligent agent may be software, e.g. a chess program that senses the chessboard and moves of the adversary and uses these outputs to select in some sense best possible move, or it may be some physical device such as a robot.

Let us review the sensors and actuators of the robot. As the robot is intended for line tracking, it is equipped with the line sensor. We have decided to use the Pololu QTR-8RC

model that consists of eight pairs of infrared emitters and receivers. The module generates 8 digital I/O signals that are connected to the digital pins of the Arduino UNO. The producer of the sensor array provides library for Arduino which simplifies integration of the sensor into the robot. The perception part of the robot consists of several steps which can be executed in parallel on all signal lines:

1 The infrared LED needs to be turned on

2 The digital pin is configured as an output and high level is set

3 The capacitor needs to be charged for at least 10μs

4 The digital pin is configured as an input

5 Time required to discharge the capacitor is measured

6 The Infrared LED is turned off

Arduino collects signals from digital 8 lines and calculates the position of the line with respect to center of the line sensors. The deviation of the line, after processing by algorithm for line following, serves as input to the motor driver Sabertooth 2x5 which can be regarded as an actuator of the robot. The Sabertooth motor driver can control two DC motors, continuously providing up to 5A to each one. The Sabertooth is a very flexible device, it can be used to control motors with analog voltage, serial, or radio control depending on its configuration that are described in detail in (6). Sabertooth offers independent operating modes for speed and direction which makes it ideal for differential drive robots; it can process up to 3000 commands per second. Additionally, it features 5V battery eliminator circuit which can be used to power the micro controller, in our case the Arduino UNO board.

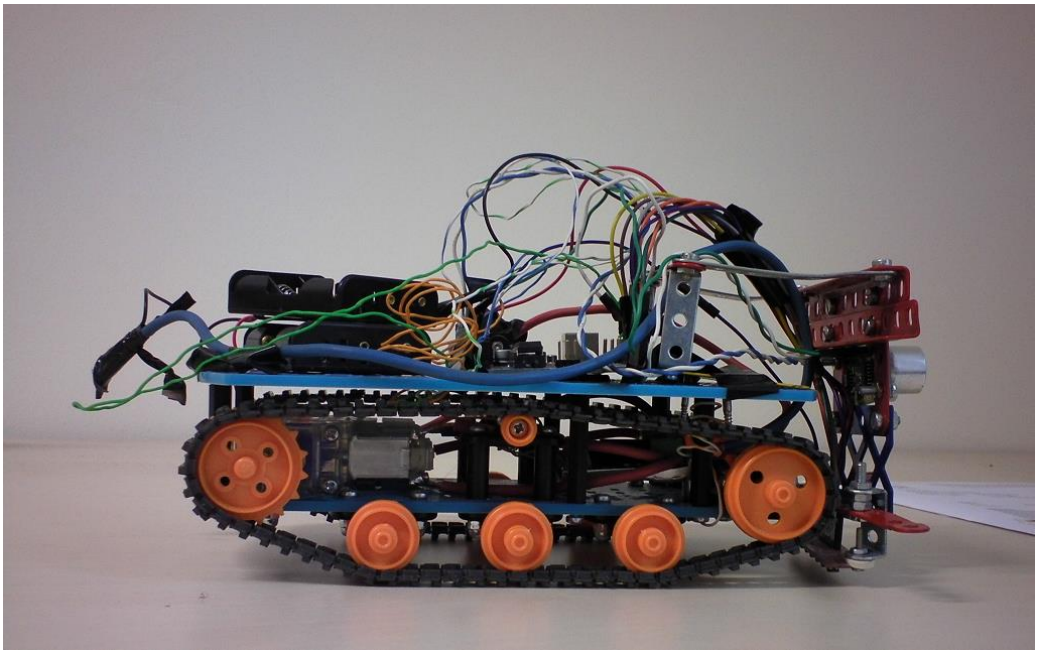

Figure 18: Sideview of the robot

In our case, the Sabertooth 2x5 controls two DC Pololu 1117 motors which drive the tank chassis through the double gearbox Tamiya 70168. Components of the robot are mounted on the construction set TANK-02 produced by the company Hobbyrobot and metal construction set Merkur. The robot is powered by 6 AA rechargeable batteries that provide the power to the motor driver that distributes it to the Arduino UNO.

In the near future, we would like to append ultrasonic ranger sensor SRF05 that could be used as an obstacle detector or for orientation of the robot in the space. We also consider a possibility of attaching the Wi-Fi shield on top of the Arduino UNO board. This would enable the remote control of the robot. Furthermore, the mapping of sensor inputs to actuators could be done outside of the Arduino.

3 Algorithm for line following

Our robot's algorithm for line following is based on implementation of a proportional-integral-derivative (PID) controller. This type of algorithm is easy to divide to elementary blocks, which is good for easier understanding and quicker learning curve. These basic blocks are:

7 proportional controller with normalized linear input

8 proportional controller with normalized non-linear input

9 derivative controller with normalized linear input

10 derivative controller with normalized non-linear input

11 integral controller with normalized linear input

12 integral controller with normalized non-linear input

Students can then see behavior of robot with different kinds of control algorithms in dependence on which blocks are used. Algorithm for the full PID controller with all blocks can be written in form of following mathematical formula:

$$u(t) = K_{p1}e_l(t) + K_{p2}e_n(t) + K_{i1}\int_0^t e_l(\tau)d\tau + K_{i2}\int_0^t e_n(\tau)d\tau + K_{d1}\frac{d}{dt}e_l(t) + K_{d2}\frac{d}{dt}e_n(t)$$

where

K_{p1}, K_{p2}- Proportional gain, a tuning parameter
K_{i1}, K_{i2}- Integral gain, a tuning parameter
K_{d1}, K_{d2}- Derivative gain, a tuning parameter
e_l – Linear error function
e_n– Non-linear error function, implementation can vary
t– Time parameter
u– Controller output

The controller output must be further transformed to control signals for motors. Example code for Arduino follows:

```
void defuz(float reaction)
{
      if (reaction < 0.0)
      {
            Left_motor = 242.0;
            Right_motor = 8.0 - reaction * 112.0;
      }
      else
      {
            Left_motor = 242.0 - reaction * 112.0;
            Right_motor = 8.0;
      }
}
```

The next important part in development process is setting of variables of the PID controller. It is difficult process for which several methods exist. The most basic way is to set it manually in steps simply by observing behavior of robot and then tuning of parameters. This approach can prove chaotic and non-effective, but it is important for learning process. More sophisticated methods such as Ziegler–Nichols (3) or Cohen–Coon (1) are usually used in a practice and when students start to understand principles of PID controller.

4 Application of the robot in education

Currently, two samples of the above described robot are assembled. It is our aim to use these robots during education of programming and algorithms at the Department of Software Engineering of the Faculty of Nuclear Sciences and Physical Engineering. We are now preparing a function library containing elementary operations such as make step, turn left, turn right, turn back, or is path clear. We would like to use this library to make students to teach the robot to drive in circles, to drive until it reaches obstacle … This will familiarize students with basic concepts including iterations, conditions, and subprograms. We believe that work with robots will be interesting even for students who do not wish to choose programming as their specialization. We would like to visit secondary schools with the robot to invite new students to our department.

Furthermore a new course Advanced algorithms will be started from the academic year 2013/2014. During the course, the robot will be used to demonstrate several selected algorithms of the machine learning, state space search, particle filters, or control theory (see above).

5 Conclusion and outlook

We have presented an Arduino based robot that is able to track line using the line sensor. It is our plan to append ultrasonic range sensor that will allow the robot to detect obstacles and to identify its position within the space. Starting from the academic year 2013/2014 we will use the robot to support education of C++ programming and algorithms at Faculty of Nuclear Sciences and Physical Engineering.

ACKNOWLEDGEMENT

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OPTIONS OF IT EDUCATION IN VIRTUAL UNIVERSITIES

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ABSTRACT

The article describes the general socio-technical system and its possible identification with the definition of the data, information and experiences model involving gradually a systemic integrated interface human-ICT system and with modelling defining requirements for the cyberspace of the technical environment (IT) and cyberspace of the social environment with a view to possible further increase in intelligence of both environment and to minimize the referred interface and shift the model to the new profile of the cybernetic concept of education in the new environment of virtual universities.

The article briefly expressed the profile of the identification of the given environment, assesses the possible mathematical modelling of IT and defined social system and the possibility of optimizing and a later simulation of interesting and promising environment created as part of the new economy in the world.

KEYWORDS

IT education, virtual university, system solution, cyberspace, mathematical modelling, new economy

1 Úvod

Nová ekonomika je a bude čím dále více založena na informacích, znalostech, systémově vymezeném a integrovaném prostředí moderních informačních a komunikačních technologiích (ICT), moderním řízení a tvorbě integrovaných modelů elektronického podnikání, elektronického vzdělávání a to u stávajících a zejména pak ve virtuálních prostředích.

Konkurence ve všech oblastech bude vždy globální s důrazem na úroveň sociálního a technického prostředí postupně vymezovaného inteligentními technickými prostředky vzniklými systémovým řešením modelů velmi složitých hierarchických struktur v kyberprostoru a také odpovídajícím zvyšováním vzdělanosti a to již dnes ve virtuálních prostředích. Tento trend vývoje je perspektivní a vytvářející novou oblast aplikované kybernetiky.

Klíčem k úspěchu bude schopnost inovovat a neustále zdokonalovat sociálně-technické prostředí pro moderní řízení celé společnosti a pružně vzdělávat v oblasti IT sociální prostředí v nové ekonomice světa. Vzniká prostor, kde tradiční transakce dat a informací jsou postupně a jistě vytlačovány novými kyberprostory vzdělávání IT.

6 Model reálného systému vzdělávání

6.1 Možnosti identifikace reálného prostředí

Na základě moderních přístupů k tvorbě modelů reálných systémů a na základě využití obecné teorie systémů a aplikačních teorií této vědní oblasti je možné definovat systém S (

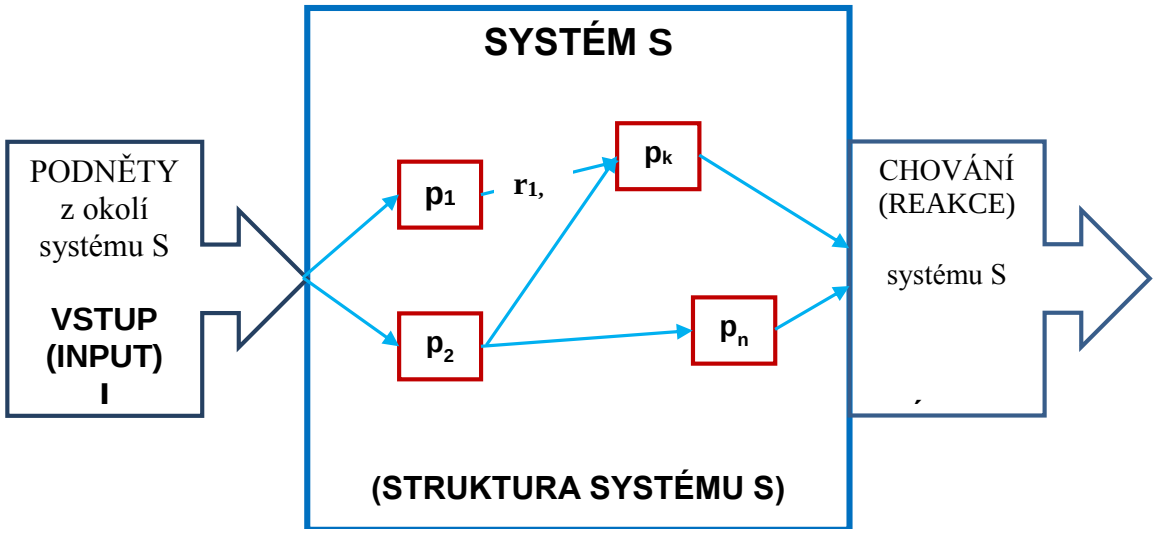
Obrázek 4) jako účelově definovanou množinu prvků P a vazeb (relací) R mezi těmito prvky množiny P

$$S = \{ P, R \}$$

kde:

$P = \{ p_i \}$, jsou na dané rozlišovací úrovni prvky p_i,
$i \in J$, pro i=1,…,k,..,,n
$R = \{ r_{i,j} \}$ jsou relace r mezi prvky s indexy i a j
$i \in J$, pro i=1,…,k,..,,n
$j \in J$, pro j=1,..k, ..,,n J

Prvky p_i systému S jsou elementární části systému S. Množinu P všech prvků p_i nazýváme universum systému. Vazby jsou vzájemné závislosti mezi prvky p_i a p_j nebo vzájemné působení mezi těmito prvky. Množina všech vazeb (vztahů, relací) R = {r_i, j}je mezi prvky p_i a p_j systému. Struktura systému může být funkční, technická, informační, časová, organizační, apod. Specifickou strukturu systému tvoří tzv. hierarchická struktura, která vyjadřuje vztahy nadřízenosti a podřízenosti reálných systémů S. Z okolí na systém S působí podněty (vstupy I do systému S na definované prvky p_i. Podněty mohou mít různý charakter: mohou být přesně definované, nebo stochastické informace, nebo šumy, nebo parazitní podněty, nebo v moderním světě pak informace kyberterorismu, atd. Systém S působí na okolí reakcí (systém reaguje na okolí tohoto systému) – a to chováním vyjádřeným jako reakce systému O (výstup systému S). Reakce systému (výstup, chování systém označené O) jsou dány vstupy I, možnostmi vlastní struktury systému S a chováním okolí daného systému (které může být deterministické, nebo stochastické, nebo statické, nebo dynamické prostředí atp.).(**Obrázek 4**)



OBECNÝ SYSTÉM S A JEHO OKOLÍ (I, O)

Obrázek 4 Systém a jeho podstatné okolí
Zdroj: vlastní zpracovaný podle (Dvořák, 2002)

Na základě procesů poznání – **analýzy** (Obrázek 5) nebo identifikace, rozpoznávání scén a prostředí v definovaném prostředí **systému S** a jeho okolí vytvoříme **model M** zvolené množiny systémů S. K procesu transformace systémů na model lze využít klasického prostředí modelování nebo moderního modelujícího prostředí – tj. sítě počítačů, obecně

informačních a komunikačních systémů (moderních technologií ICT). Model M zvolené množiny systémů S je vyjádřen vhodným jazykem (jako prostředkem sdělování informace mezi systémy) a to ve formě textové informace – tj. přirozeným jazykem, dále matematickým jazykem – tj. prostředky matematiky a fyziky atd.).

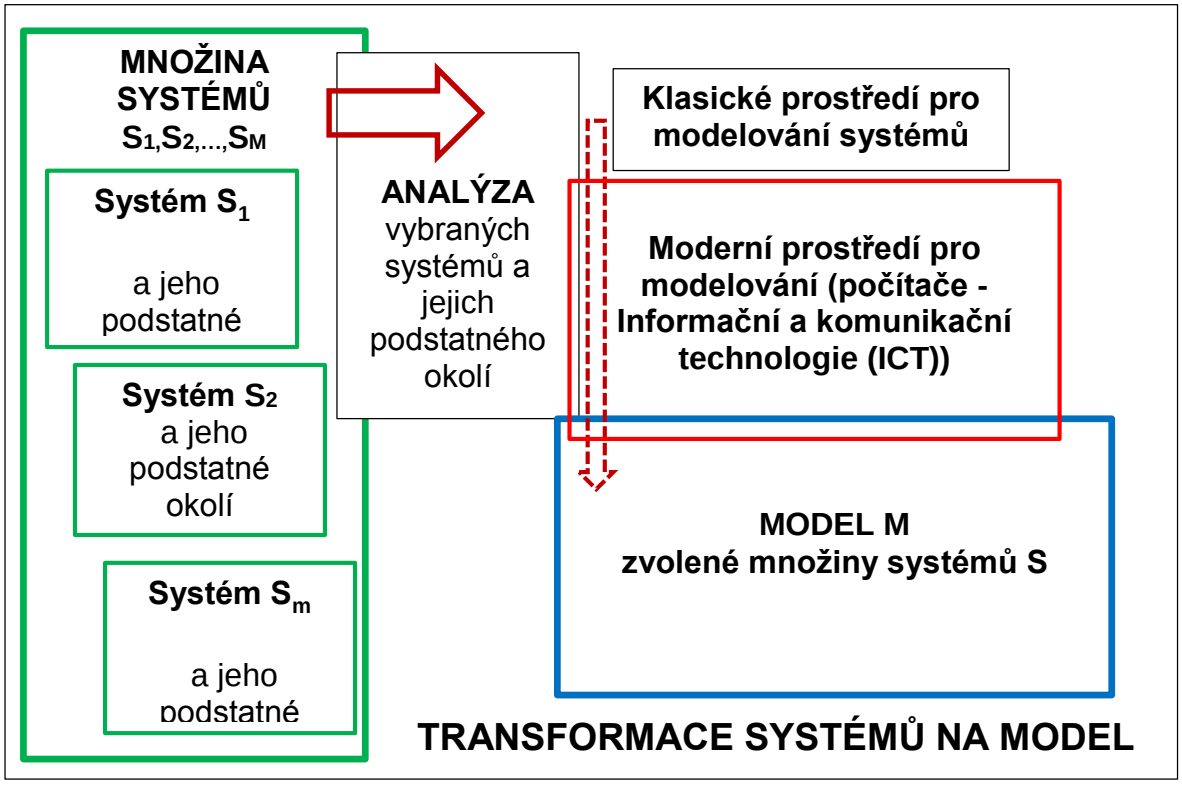
Jestliže systém S_i (z množiny systémů $S_1,S_2,\ldots,S_m$ se svými podstatnými částmi okolí) je reprezentován nově **kybernetickým systém** KS_i, pak uvedené reálné prostředí systému S můžeme vyjádřit následujícím obrázkem (Obrázek 5).

Množina kybernetických systémů KS tvoří matici prvků $KS_{i,j}$ (i=1,2,…,n j=1,2,…,m) a propojení relacemi mezi těmito prvky. Je vytvořena **hierarchická struktura kybernetických systémů** označená KS (Obrázek 6

Jestliže vyjádříme systém S_i (Obrázek 5) jako kybernetický systém, pak uvedený bude obsahovat podsystém KS_i a v maticovém vyjádření další kybernetické podsystémy KS_i,protože každý řídicí podsystém kybernetického systému může být zase kybernetickým systémem v další vrstvě a vzniká **hierarchická struktura kybernetického (kybernetických) systémů KS** (

Obrázek 6). Uvedené prostředí hierarchické struktury KS je pracovně rozděleno na:

- technické prostředky IT (tvořící reálné prostředí systému technického zabezpečení vzdělávání „T“,
- sociální systém (tvořící reálné prostředí sociálního systému pro vzdělávání „V“,
- rozhraní mezi technickými prostředky a sociálním systémem „X“ (tvořící systém vztahů „člověk – stroj“ v tomto případě „studující – prostředky ICT).(Obrázek 6)



Obrázek 5 Transformace systémů na model; Zdroj: vlastní

Rámcové vymezení identifikace reálného prostředí vzdělávání je vyjádřeno (Obrázek 5) a tvoří množinu klasických metod analýzy systémů a transformaci tohoto procesu na model M. Moderní pojetí analýzy je spojeno s využitím ICT prostředí pro rozpoznávání těchto analyzovaných systémů S_i.

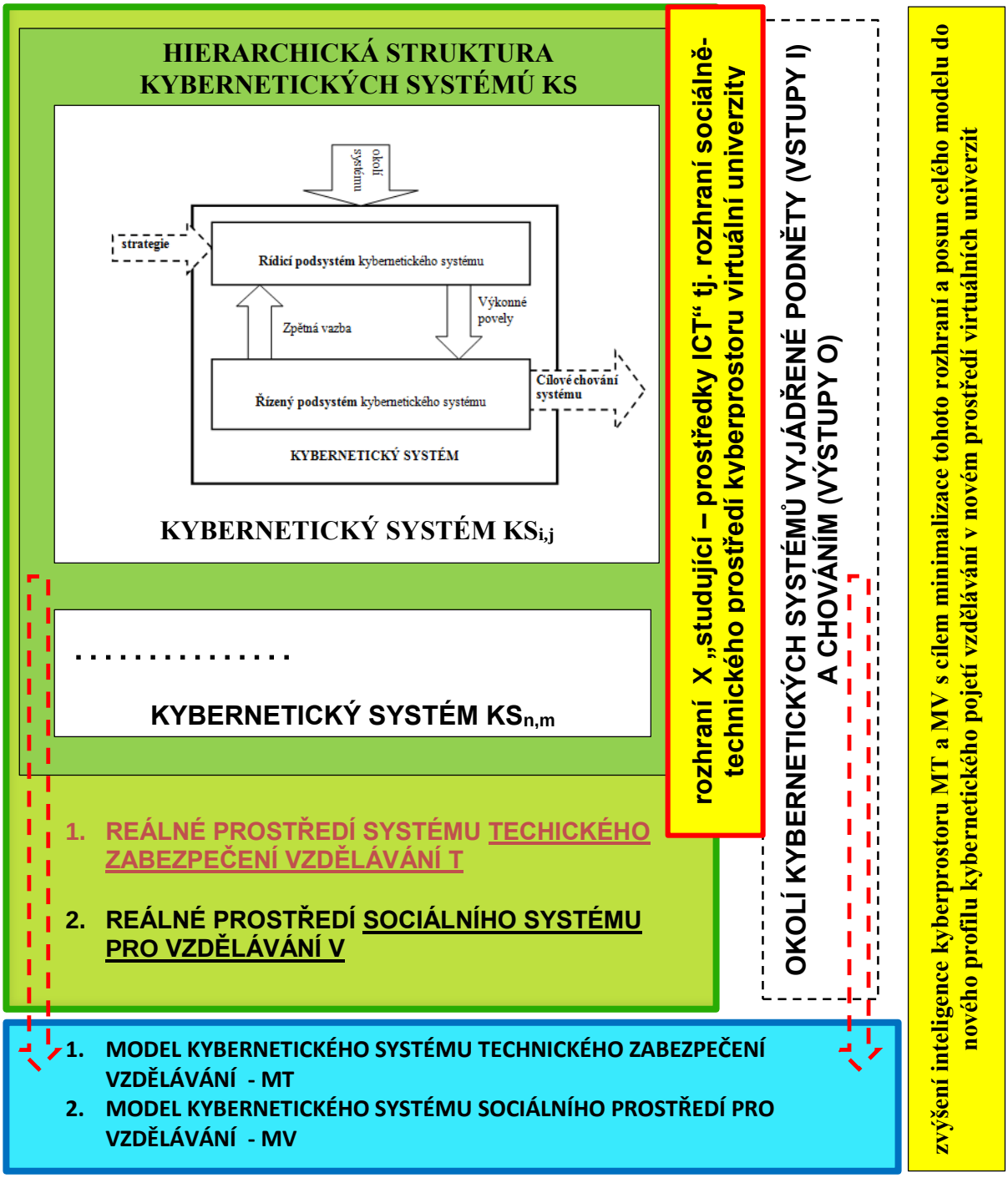
6.2 Možnosti tvorby kyberprostoru vzdělávání

Velmi složitou otázkou současně řešeného výzkumu je k tradičním dynamickým prostředím (Obrázek 6) „T“, „V“ a „X“ vytvořit množinu modelů vyjadřujících dynamiku a adaptabilnost kybernetických systémů a obecně zejména jejich pružného okolí:

- model kybernetického systému technického zabezpečení vzdělávání „MT“,
- model kybernetického systému sociálního prostředí pro vzdělávání „MV“,
- model rozhraní „X“ „studující – prostředky ICT“ tj. rozhraní sociálně-technického prostředí kyberprostoru virtuální univerzity,
- model okolí kybernetických systémů vyjádřené podněty (vstupy I) a chováním (výstupy O),

s cílem zvýšení inteligence kyberprostoru MT a MV, minimalizace (optimalizace) tohoto rozhraní a posun celého modelu do nového profilu kybernetického pojetí vzdělávání v novém prostředí inteligentních virtuálních univerzit (s modely umělé inteligence).

Vytvoření celého systémově pojatého kyberprostoru je vyjádřeno na (Obrázek 7), kde jsou uvedeny tři modely: kyberprostoru ICT (vyjádřeného modelem IT – tj. technickým, programovým a komunikačním prostředím atd.), kyberprostoru učení (vyjádřeného modelem reálného sociálního a organizačního prostředí apod.), kyberprostoru vzdělávání (vyjádřeného uvedenými kybernetickými systémy tvořícími model „sociálně-technického prostředí“ tohoto velmi složitého dynamického, adaptabilního a inteligentního kyberprostoru s prostředky a modely umělé inteligence v kyberprostoru moderní bezpečnosti informací a dat atd.).

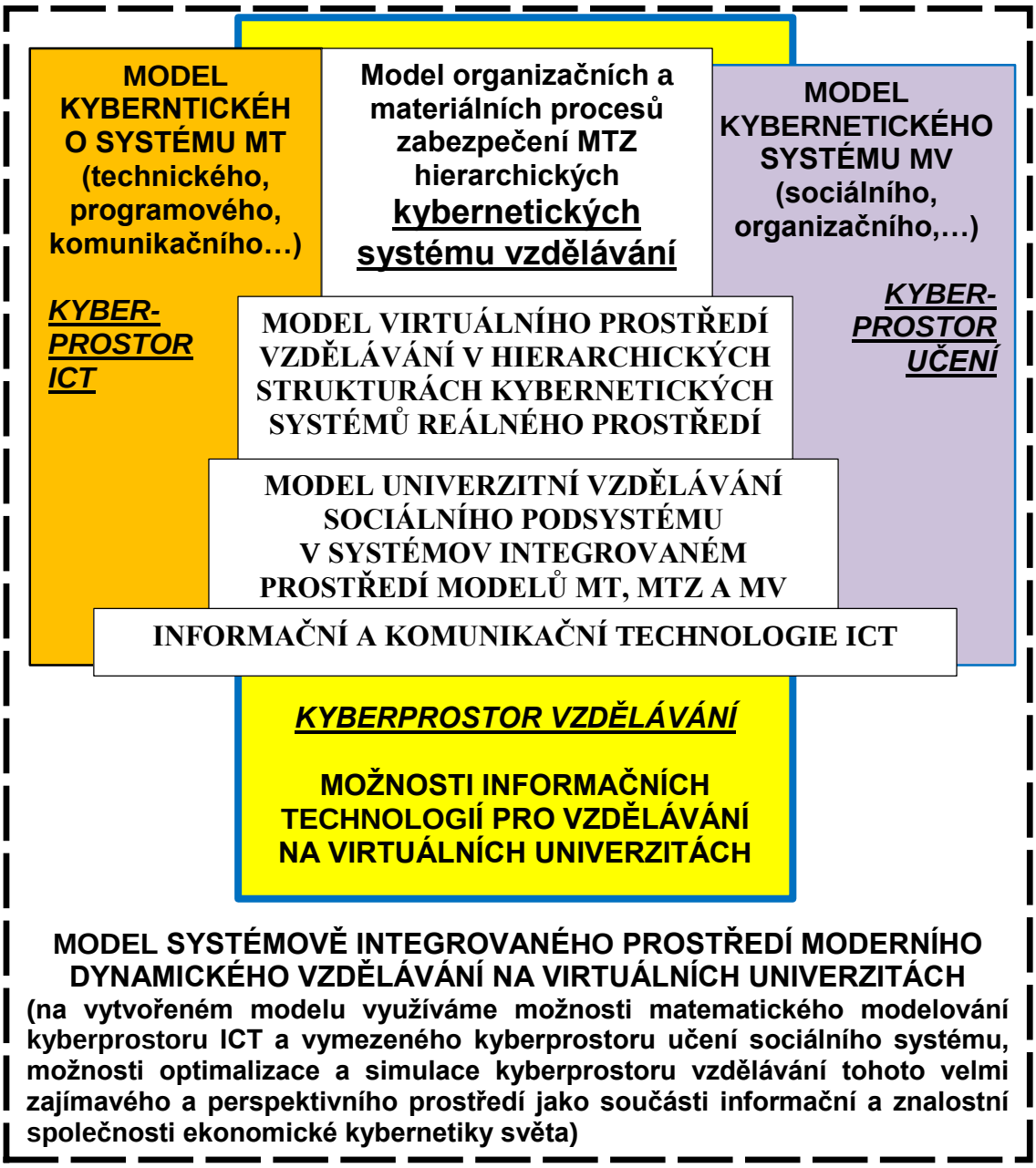


Obrázek 6 Modely kybernetických systémů T a V; Zdroj: vlastní

7 Model možnosti IT vzdělávání na virtuálních univerzitách

7.1 Výzkum v oblasti modelování kyberprostoru vzdělávání

Na základě prováděné analýzy současného klasického vyučování na *„kamenných univerzitách“* tj. klasického vyjádření hierarchicky členěných oborů, specializací, předmětů atd. jako modelů kyberprostorů v systémově definovaném prostředí technického zabezpečení vzdělávání, sociálního prostředí vzdělávání a rozhraní obou těchto kyberprostorů s uvažováním ještě modelu speciálního kyberprostoru přednášejících, lektorů atd. – tedy



Obrázek 7 Model prostředí virtuální univerzity v kyberprostoru MT, MV a MTZ; Zdroj: vlastní

v modelu dnes existujícího pedagogického a odborného kyberprostoru sociálního systému. Vyhodnocování tohoto dynamického a pružného, deterministického i stochastického a pružného a adaptabilního prostředí je vysoce náročné a to s překonáváním různých i konzervativních a historicky tradičních forem vzdělávání sociálního systému nyní již pro nové podmínky rozvíjené moderní vědy, výzkumu a také praktických aplikací revolučního technologického procesu ve světě a nových fyzikálních principů, materiálových technologií apod.

7.2 Model adaptabilního systému virtuálních univerzit

Na základě publikovaných odborných článků ve světě je proces modelování virtuálních univerzit spojen s dynamikou vývoje informační společnosti tj. především s popisem možností IT v procesu projektování univerzitního vzdělávání kyberprostoru sociálního systému z pohledu potřeb:

- vzdělávání různými „hybridními“ formami výuky,
- propojování kyberprostorů s cílem perspektivní systémové integrace těchto prostředí,
- přizpůsobení různých heterogenních sítí IT s preferováním internetového prostředí světa,
- nových integrovaných kyberprostorů u všech uvedených tří oblastí,
- filtrací různých prostředků kyberterorismu atd. v oblasti tohoto nebezpečného fenoménu již existující kybernetické války ve světě,
- přesné oddělení vzdělávacího prostředí kyberprostoru v čase a reálném systémovém prostoru světa,
- aktivního rozvíjení požadovaných a predikovaných znalostí a dovedností v celém sociálním spektru tohoto kyberprostoru,
- synchronizace uvedených složek kyberprostoru s cílem poskytování alternativních metod studia,
- chápání víceúrovňových strategií výchovného a vzdělávacího procesu a učení ve všech třech úrovních uváděného kyberprostoru,
- překonávání klasické prostorové a časové bariéry v novém pojetí e-learningu ve virtuálním kybernetickém systému vzdělávání na univerzitách.

Předpokládané výhody virtuálních univerzit:

- rozvoj a využívání ICT a moderních prostředků IT v uvedených modelech kyberprostorů s možností jejích systémové integrace,
- hierarchické pojetí kybernetických systémů ve virtuálních univerzitách přinese možnost nevídaného celosvětového přenosu informací a znalostí, vzdělanosti a kultury, atd.

Nevýhody lze spatřovat:

- např. v pojetí autorských práv a obecně v právním prostředí kyberprostoru,
- náklady spojované s bezpečným kyberprostorem virtuálních univerzit.

8 Závěr

Přínosem řešeného projektu je systémové vymezení kyberprostorů virtuálních univerzit a modelování uvedených prostředí s novými možnostmi projektování informačních a komunikačních systémů v hierarchických kybernetických systémech moderní virtuální univerzity.

Příspěvek je výstupem projektu specifického výzkumu „*Využití ICT a matematických metod při řízení podniku*“ tematická část tohoto projektu: „*Systémově integrované prostředí pro návrh inteligentních modelů, modelování a simulací moderního kyberprostoru podniku*“ Interní grantové agentury Vysokého učení technického v Brně s registračním číslem FP-S-13-2148 (2013-14).

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TRAINEESHIPS FOR YOUNG ICT STUDENTS AS A TOOL TO OBTAIN PRACTICE

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ABSTRACT:
The aim of this paper is to characterize the project by the Fund for further education titled Traineeships for young people. The paper will explain the position offered by ICT, their description and required skills. It describes the process and requirements for i mentor of ICT internships.

KEYWORDS:
Processes, Project, Traineeships, Position by ICT.

1 Úvod

České vysokoškolské prostředí a způsob přípravy nových vysokoškolských vzdělaných lidí se dostal v našich zemích na rozcestí. Chceme-li udržet konkurenceschopnost našich podniků v globálním prostředí, musíme myslet globálně i při změnách a plánované transformaci vysokoškolského systému. Nesmíme však zapomenout na jednu věc. Nelze jen kopírovat globální vzory, musíme i zde myslet lokálně a hledat nové přístupy a nové cesty. Vždyť globální trhy a globální podniky ocení konkrétní zkušenosti a nové přístupy k řešení potřeby nových kompetencí vysokoškolských vzdělaných lidí. Není cesta memorování a informací, je cesta hledání nových znalostí založených na dovednostech a zkušenostech. Profesor Zelený k tomu říká:

„Svobodný trh dnes prosazuje samoslužbu (self-service), odstraňování zbytečných mezičlánků (disintermediation), masovou kustomizaci a individualizaci výrobků a služeb (mass customization), jakož i novou lokalizaci hospodářské činnosti, počínaje od zemědělství (precision a vertical agriculture), ale rozšiřující se i do výroby a služeb, startující nový cyklus sektorového rozvoje, tentokrát na lokální úrovni. „Mysli globálně a jednej lokálně“ vystihuje historickou transformaci „

Think globally, act locally je heslo, které je v souvislosti s globalizací a nástupem komunikačních technologií velmi často uváděno. Možná by bylo užitečné k první a druhé části hesla připojit vztah ekvivalence. Tedy nejen nejdříve mysli globálně, ale pak jednej lokálně, jinak předpokladem lokálního konání je globální myšlení. Zároveň však platí v ekvivalenci i opačný vztah - z předpokladu globální myšlení vychází lokální konání. Jedním z dobrých příkladů vzdělávací inovace je realizace projektu Stáže ve firmách.

9 Stáže ve firmách jako příklad úspěšné inovace

Fond dalšího vzdělávání (FDV), příspěvková organizace Ministerstva práce a sociálních věcí (MPSV), v červnu 2012 zahájil realizaci projektu Stáže ve firmách - vzdělávání praxí (registrační číslo CZ.1.07/3.1.00/41.0001). Hlavním cílem projektu je zavedení inovativního systému dalšího vzdělávání prostřednictvím stáží ve firmách a zvýšení uplatnitelnosti občanů na trhu práce. Projekt je určen pro občany České republiky nebo pro osoby s trvalým pobytem na území České republiky (mimo OSVČ a osoby se statusem studenta), které mají trvalé bydliště mimo hlavní město Praha. V první fázi bude v rámci projektu vzděláváno 5.000 účastníků. Zároveň budou zmapovány potřeby úpravy legislativy tak, aby se poskytování stáží stalo pro firmy atraktivním způsobem, jak získat kvalifikované

pracovníky, a zvýšilo jejich motivaci stáže poskytovat. Projekt by měl i napomoci k ukotvení způsobu dalšího vzdělávání formou stáží do české legislativy.

Důvody vzniku projektu jsou nasnadě – nejen České republika, ale celá Evropská unie se potýká s nedostatkem pracovních příležitostí pro mladé uchazeče o zaměstnání. Většina firem absolventy nechce přijmout právě kvůli chybějícím praktickým zkušenostem. Tento nedostatek by měl nově kompenzovat projekt Stáže pro mladé zájemce o zaměstnání, který poskytnutím pracovní praxe přispěje ke zvýšení zaměstnanosti a konkurenceschopnosti budoucích absolventů na trhu práce. Projekt má také za cíl usnadnit navázání kontaktů mezi zaměstnavateli a potenciálními zaměstnanci, ale především – žáci a studenti získají prostřednictvím stáže pracovní návyky a praktické zkušenosti ze svého oboru, které tolik potřebují. Projekt Stáže pro mladé přesahuje běžný rámec školních osnov, tudíž jeho úkolem není tyto osnovy doplňovat či upravovat, nýbrž řešit nezaměstnanost absolventů škol na trhu práce. Pro uchazeče o stáž to znamená, že se jedná o volnočasovou aktivitu, která žádným způsobem nezasahuje do jejich školních povinností

9.1 Hlavní přínos stáží

Jednou z překážek, s níž se absolventi po odchodu ze školy musí potýkat, je jejich nedostatečná praxe. Projekt Stáže ve firmách – vzdělávání praxí napomáhá tento problém efektivně řešit – absolventi mohou po ukončení studia nastoupit na stáž do firem, které podnikají v jejich oboru, mohou si tak ověřit svoje znalosti a dovednosti v praxi a vylepšit svou pozici na trhu práce. Pro nezaměstnané, eventuálně osoby, které se na trh práce vracejí po určité pauze, je stáž užitečným prostředkem k poznání, jak se za dobu, kdy byli bez stálého místa, změnila situace v jejich oboru.

Po úspěšném ukončení stáže získají účastníci certifikát o jejím absolvování. Stáž ve firmě představuje investici stážisty do své vlastní budoucnosti a možnost lepšího uplatnění na trhu práce.

9.2 Co získají účastí na projektu partnerské firmy

Podnikatelské subjekty, které se zapojí do projektu Stáže ve firmách – vzdělávání praxí, dostanou ojedinělou možnost zaškolit a vychovat si budoucí odborníky v oblasti, ve které podnikají. Možností (nikoli povinností) je tyto stážisty následně zaměstnat. Zapojení se do projektu může navíc napomoci zdokonalit interní vzdělávací mechanismy dané společnosti. Náklady na stáž budou hrazeny z fondů Evropské unie, a to při splnění všech podmínek stáže.

Zapojení se do projektu má však značné výhody i pro samotné poskytovatele stáží. Těm účast v projektu dává příležitost „odzkoušet“ si možného budoucího pracovníka a zavázat si ho případně k další spolupráci (ta však není podmínkou). V neposlední řadě firma obdrží částečnou náhradu mzdy mentora, která vychází z průměrné mzdy dle oborů v jednotlivých krajích. Veškeré náklady na refundaci mzdy mentora a proplacení mzdy stážisty budou poskytovateli uhrazeny po úspěšném vyhodnocení stáže. Poskytovateli stáže se mohou stát pouze soukromé subjekty podnikající na území České republiky a disponující mentorem, který stážistu povede v průběhu působení ve firmě.

10 ICT pozice v projektu Stáže ve firmách

V rámci projektu jsou definovány pozice svými šablonami – konkrétně Kodér webu, Programátor, Programátor analytik, Správce sítí, Technik IT a Webový grafik. Šablona stáže představuje základní rámec odborné stáže pro typovou pozici a obsahuje požadavky na obsah

a průběh stáže, na stážistu i na poskytovatele stáže. Šablona stáže je výchozím dokumentem k vystavení konkrétní karty stáže poskytovatele a definuje hlavní požadavky na stážistu.

10.1 KODÉR WEBU

Níže je uveden výčet činností, které bude stážista během své odborné stáže vykonávat. Povinností poskytovatele stáže je zajistit, aby se stážista se všemi níže uvedenými činnostmi prakticky seznámil. Pokud není možné z objektivních důvodů (např. sezónnost vykonávaných činností, cyklus výroby, životní cyklus projektu apod.) v průběhu trvání stáže zajistit praktický nácvik všech níže uvedených činností, je povinností poskytovatele stáže seznámit stážistu s těmito činnostmi alespoň teoreticky. Pro pozici kodér webu to jsou

a) Užívání HTML a XML jazyků pro tvorbu a rozvoj webových aplikací.
b) Užívání technologie JavaScript v prostředí webových prezentací.
c) Tvorba a užívání základních datových struktur a modelů.
d) Seznamování se s koncepcí modelů Klient-Server a Model-View-Controller.
e) Seznamování se s programovacími jazyky PHP, ASP.Net a Java.
f) Seznamování se s databázovým jazykem SQL.

Níže je uveden výčet odborných kompetencí, jejichž osvojení, trénink a nabytí je předmětem realizace stáže. Nabytí uvedených odborných kompetencí bude zajištěno výkonem činností na stáži.

a) Znalost a orientace ve WWW technologiích.
b) Návrh a tvorba WWW prezentace s aktivními a dynamickými prvky.
c) Rozvoj a udržování WWW aplikací.

10.2 PROGRAMÁTOR ANALYTIK

Programátor analytik je pracovník kvalifikovaný v oblasti algoritmizace a softwarového inženýrství, který na základě analýzy procesů a požadavků uživatelů vytváří konceptuální diagramy informačních systémů

a počítačových aplikací. Součástí jeho pracovní náplně je testování softwarových aplikací z hlediska jejich ergonomie, funkčnosti a užitnosti. Programátor analytik je schopen posoudit jakost a funkcionalitu softwaru podle mezinárodních ISO norem.

Vykonává činnosti:

a) Návrh ICT řešení dle zadaných specifikací v podobě business a konceptuálních diagramů, scénářů aj., se zajištěním rozhraní na stávající informační systémy organizace.
b) Návrh datového modelu včetně návrhu databázového řešení (MVC) a integrace se stávajícími systémy a ICT strukturami organizace.
c) Výběr a zavedení nástrojů softwarového inženýrství potřebných pro tvorbu navrhovaného řešení.
d) Výběr a zavedení testovací nástrojů pro realizované ICT řešení.
e) Tvorba a vedení dokumentace k ICT řešení, z hlediska jeho návrhu, realizace, testování a zavádění.
f) Procesní a metodické řízení systémové a datové integrity navrhovaných řešení se stávajícími ICT strukturami organizace.

g) Zavádění a řízení procesů implementace ICT řešení včetně harmonizace s uživatelským prostředím.

h) Zavádění a řízení procesů provozu a údržby ICT realizovaných řešení včetně změnového řízení.

i) Návrh a řízení procesu legislativních a metodických změn v uživatelských aplikacích.

Níže je uveden výčet odborných kompetencí, jejichž osvojení, trénink a nabytí je předmětem realizace stáže. Nabytí uvedených odborných kompetencí bude zajištěno výkonem činností na stáži.

a) Analýza, návrh, zavedení a řízení procesu systémová a datové integrace ICT řešení.

b) Návrh ICT řešení podle požadavků zákazníka (business modely).

c) Návrh a tvorba konceptuálních a datových modelů ICT řešení.

d) Řízení procesu implementace ICT řešení včetně harmonizace s uživatelským prostředím.

e) Návrh a zavedení procesu provozu a údržby ICT řešení.

f) Vytváření ICT dokumentace včetně předávací dokumentace.

g) Vytváření uživatelské dokumentace počítačových aplikací.

h) Analyzování procesů, legislativních a technických podmínek a požadavků uživatelů.

10.3 SPRÁVCE SÍTÍ PRO MALÉ A STŘEDNÍ ORGANIZACE

Níže je uveden výčet činností, které bude stážista během své odborné stáže vykonávat.

a) Návrh a implementace počítačové sítě za pomoci síťových prvků a uživatelských stanic.

b) Návrh a implementace bezpečnostních prvků počítačové sítě.

c) Správa sítě, síťových prvků a síťového připojení uživatelských stanic.

d) Monitorování a diagnostika počítačové sítě.

e) Detekce a náprava poruch a vad počítačové sítě na straně síťových prvků i uživatelských stanic.

f) Tvorba a analýza dokumentace o návrhu, implementaci a stavu počítačové sítě.

g) Stanovení potřeb, komunikace s uživateli.

Nabytí uvedených odborných kompetencí bude zajištěno výkonem činností na stáži.

a) Navrhování topologie počítačové sítě.

b) Instalování a spravování aktivních a pasivních síťových prvků.

c) Instalování a spravování bezpečnostních prvků počítačové sítě.

d) Vedení a spravování incidentů počítačové sítě.

e) Vytváření a provádění servisní podpory uživatelům koncových stanic.

f) Rozšiřování odborných znalostí, sledování aktuálních trendů a technologií.

10.4 Základní požadavky na mentora stáže

Pro prokázání schopnosti poskytovatele stáže zajistit řádný průběh odborné stáže je nezbytné, aby mentor splňoval alespoň jeden z níže uvedených základních požadavků (a, b, c).

a) Osoba vykonávající činnost mentora musí být u poskytovatele stáže zaměstnána na hlavní pracovní poměr s úvazkem 1,0 po dobu nejméně 6 měsíců před vypsáním karty stáže.
b) Pokud je osoba vykonávající činnost mentora členem statutárního orgánu poskytovatele, musí tuto činnost vykonávat nejméně 6 měsíců před vypsáním karty stáže.
c) Pokud je osoba vykonávající činnost mentora osobou samostatně výdělečně činnou (OSVČ), musí mít po dobu minimálně 6 měsíců před vypsáním stáže v živnostenském listu uvedenu činnost v oboru, ve kterém bude mentorovat.

Své zkušenosti dokládá předložením referencí od 3 různých subjektů. Detailní informace jsou uvedeny v Manuálu pro poskytovatele.

11 Zkušenosti Vysoké školy podnikání s projektem.

Stáž na škole absolvovalo celkem o 5 absolventů v IT oblasti. Stážisté v IT oblasti se podíleli na vývoji konkrétního softwaru Cloud Idea, včetně analýzy a vlastního programování. Software je určen pro podporu start–upů firem. Mezi kritéria patřily zájem o práci, aktivní přístup k řešení zadaných úkolů, ochota se dále vzdělávat a samostatná práce. Pochopitelně základní odborné znalosti v dané oblasti. I díky osobním pohovorům se všemi uchazeči jsme byli velmi spokojeni a nedošlo k předčasnému ukončení stáže.

V konkrétních případech jsme si ověřili (jako škola) že cesta k lepšímu uplatnění na trhu práce vede nejen přes vědomosti, ale prostřednictvím znalostí a zkušeností. Stážisté se podíleli na chodu a zabezpečení studentských firem a realizace nabídky jejich produktů prostřednictvím internetového podnikání.

Projekt lze celkově hodnotit jako projekt, který skutečně přispívá k lepšímu uplatnění absolventů na trhu práce. Nejde o slova, ale i činy. Kdy se propojuje škola, firmy a absolventi.

V našem regionu, který bojuje stále s nezaměstnaností, jde o jednoznačně pozitivní efekt a příklad aktivní politiky zaměstnanosti s využitím evropských fondů. Zkušenosti jsou mnohdy podmínkou zaměstnavatelů, ty absolventům projekt přináší. Včetně příslušného certifikátu.

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ENTERPRISES AND INTERNET OF THINGS

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ABSTRACT:
In this article, I present a survey of technologies, applications and research challenges for Internet of Things regarding enterprises. The Internet of Things (IoT) is a concept which has its roots in various network, sensing and information processing approaches. It is seriously gathering momentum and taking up speed. Internet of Things, the concept of everyday devices such as household appliances and RFID tagged objects being connected and communicating to each other via Web, is coming to the corporate world sooner than many IT administrators might think. Main aim of the article is to collect all necessary information for further steps and decision making enterprise processes.

KEYWORDS:
Internet of Things, cloud computing, service oriented architecture, sensors, RFID, intelligent household, machine to machine communication

1 Úvod

Samotná definice toho, co vlastně je či není internet věcí (IoT), není vůbec jednoznačně vymezena. V obecném pojetí můžeme chápat internet věcí jako koncepci počítačové sítě, kdy spolu komunikují jednotlivá zařízení díky vlastní vestavěné inteligenci a nikoli jen jako nástroj lidské činnosti. Často se také rozlišuje mezi konceptem stroj-stroj komunikace (machine to machine - M2M), které je vnímáno jako komunikace strojů na základě předem nadefinovaných vzorců, obvykle pravidelného a deterministického charakteru. Jak uvádí (Černý, 2013) v pravém internetu věcí se věci chovají podobně jako uživatelé – komunikují, když je potřeba, umí si aktivně říci o informace nebo je naopak distribuují dále.

Internet věcí se začal používat již v roku 1999, nicméně, jeho vzrůstající popularita je způsobena několika novými trendy. Ve spotřebitelském světě jsou široce používány produkty, jako jsou inteligentní termostaty a pedometry. V podnicích je možné sledovat trend využívání vlastních zařízení pro pracovní účely (Bring Your Own Device – BYOD). Tato skutečnost je jedním z hlavních faktorů adopce internetů věcí do podnikových infrastruktur jak uvádí (Merritt, 2013). V rámci BYOD, společnosti musí umožnit osobní zařízením (notebooky, chytré telefony a tablety) aby fungovaly v podnikové síti a měly přístup k firemním informacím. Tento přístup sebou samozřejmě přináší problémy pro ICT oddělení, které nemají přímou kontrolu nad zařízeními, které se připojují do podnikové síťové infrastruktury.

Budoucnost internetu věci v podnicích, je právě v přístupu jakým podniky zareagují na tyto nové trendy propojení jinak nesourodých zařízení. Toto propojení je řešeno nejen pro stránce hardwarové, ale také po stránce softwarové. Podnikové systémy musí zajistit, že tyto zařízení budou pracovat spolehlivě, bezpečně a navíc data, která budou produkovat, musí být zpracovatelná a pro podnik přinášející přidanou hodnotu.

2 Faktory rychlé adopce IoT

Základní faktory mohou být děleny na softwarové a hardwarové. Pokud jde o jednotlivá technologická řešení, která se v rámci internetu věcí objevují, můžeme vnímat různé roviny implementace, podle toho, jaká vrstva ISO OSI modelu je využita. Velkým

krokem je budoucí masivní rozšíření IPv6 ke koncovým uživatelům, kde bude důležitý nejen velký adresní prostor pro jednotlivá zařízení či snadné směrování s anycast adresou, ale také třeba podpora mobility, bezpečnosti či kvality služeb (QoS).

Z pohledu softwarového hrají zásadní roli čidla v mobilních zařízeních, které mohou se softwarem získat informace, které by byly jinak velmi obtížně dosažitelné. Jedná se především o prvky jako gyroskop, čtečka otisku prstů, kompas, GPS senzor, atd. V této chvíli neexistuje jednotné softwarové řešení, které by umožnovalo se standardizovaným způsobem se připojovat k různým zařízením a senzorům bez ohledu na platformu nebo topologii sítě. Jak je vidět na obrázku číslo 1. penetrace senzorů do mobilních zařízení je na velké úrovni a všechny základní ekosystémy mobilních zařízeních nabízejí různé způsoby využití.

Sensor type	iOS 5	Android	Windows 8
Ambient light sensor	✓	✓	✓
Audio (microphones)	✓	✓	✓
Camera(s)	✓	✓	✓
Humidity sensor		✓	
Inertial motion sensors			
• Accelerometer	✓	✓	✓
• Magnetometer	✓	✓	✓
• Gyroscope	✓	✓	✓
Pressure sensor (barometer)		✓	
Proximity sensor	✓	✓	✓
Temperature	✓	✓	✓

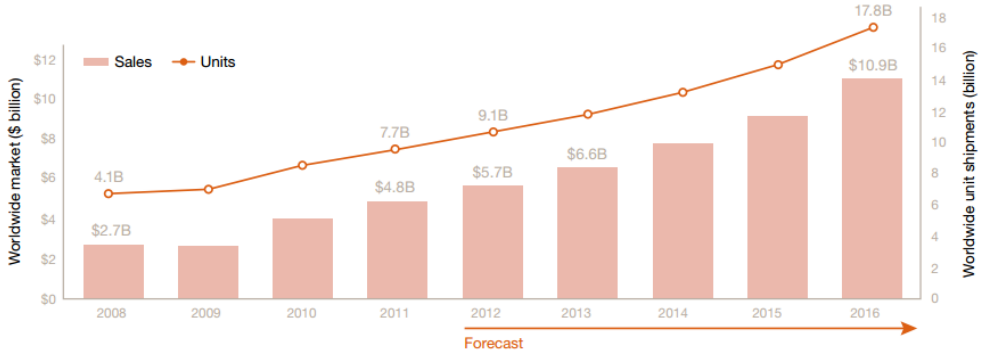
Obrázek 8 - Senzory mobilních zařízení. Zdroj: (Chen, 2012)

Technologií, která je s internetem věcí či M2M spojená snad nejvíce je RFID (Radio Frequency Identification Device). Umožňuje snadné sledování pohybu objektů a jejich tras, užívá se třeba u digitálního mýta, ochrany majetku či pro elektronické klíče. Technologie stojí od fyzické vrstvy až po spojovou, což je výhodné z hlediska snadného návrhu specializovaných zařízení pro internet věcí.

Růst rychlosti adopce internetu věcí, je zásadně ovlivňován následujícími čtyřmi faktory:

- Snižující se náklady na připojení k internetu.
- Zpřístupnění internetového pásma pro mobilní zařízení.
- Globální pronikání a přijetí chytrých telefonů (možnost instalace aplikací) a tabletů do společnosti.
- Technologické prvky, které jsou zabudovány v moderních přístrojích, jako jsou senzory, rozpoznávání obrazu a Near Field Communication (NFC) technologie.

Právě rozšíření senzorů a jejich miniaturizace je hlavím pilířem vzniku nové infrastruktury internetu věcí. Snímače a senzory byly používány po roky v automobilovém průmyslu, zdravotnictví nebo výrobě. V současné době jsou dostatečně malé a levné, aby mohly být součástí moderních zařízení, jakou jsou ledničky, pračky nebo prvky aktivního ovládání a ochrany domácností. Podle IC Insights (Baya, 2013), bude po celém světě počet prodaných senzorů ročně narůstat o 18 procent mezi lety 2011 až 2016. Jak je vidět na obrázku číslo 2. během téhož období se jednotkové množství zvýší z cca 8 miliard až na 18 bilionů vyprodukovaných kusů senzorů.



Obrázek 9 - Predikce množství vyprodukovaných jednotek senzorů a generovaných příjmů. Zdroj: (Baya. 2013)

2.1 Aplikační programové rozhraní – klíčový faktor

Vzestup internetu věcí závisí na celé řadě podpůrných technologií, jako je RFID, IPv6, zpracování velkých objemů dat (Big Data) a rozhraní pro programování aplikací (API). Web API, nebo přesněji REST API, jsou klíčové pro připojení různorodých zařízení k Internetu. Tyto aplikační rozhraní jsou využívány především díky mobilním zařízením a dynamickým webovým uživatelským rozhraním.

Organizace, které chtějí využít obchodní příležitosti v rámci internetu věcí, s přístupem přes REST API musí velmi důkladně zvážit samotný management a poskytování API rozhraní jak uvádí (Thielens, 2013).

Management API obsahuje také mechanismy pro kontrolu vývojářů a jejich práva při kontrole samotného rozhraní. Vývojáři musí získat přístup k prostředkům, které umožní napojení software na objekty a věci, které mají být na API napojeny nebo pomocí API ovládány. Příkladem mohou být API management pravidla mobilních zařízení na platformách Apple iOS a Google Android. Vývojáři mají jasně stanovené podmínky pro zaslání upozornění na zařízení nebo vyžádání konkrétní informace od zařízení.

API neslouží pouze pro přizpůsobení rozhraní nebo jeho ovládání. V rámci IoT jsou důležitou součástí z důvodu schopnosti propojení aplikací a zařízení buď jednotlivě, nebo agregovaně. Auto napojené na centrální dispečink může být na dálku zamknuto nebo i zastaveno. API zařízení na sledování sportovní aktivity, může zasílat reklamní zprávy podle momentálního výkonu nebo stavu svého majitele. Na výše uvedených příkladech je jasně vidět, že proti sobě stojí vývojáři API, zařízení a uživatelé těchto zařízení s různými požadavky na management API, právy na jejich využití a úrovněmi zabezpečení.

3 Problematika velkých dat a bezpečnosti

3.1 Big data

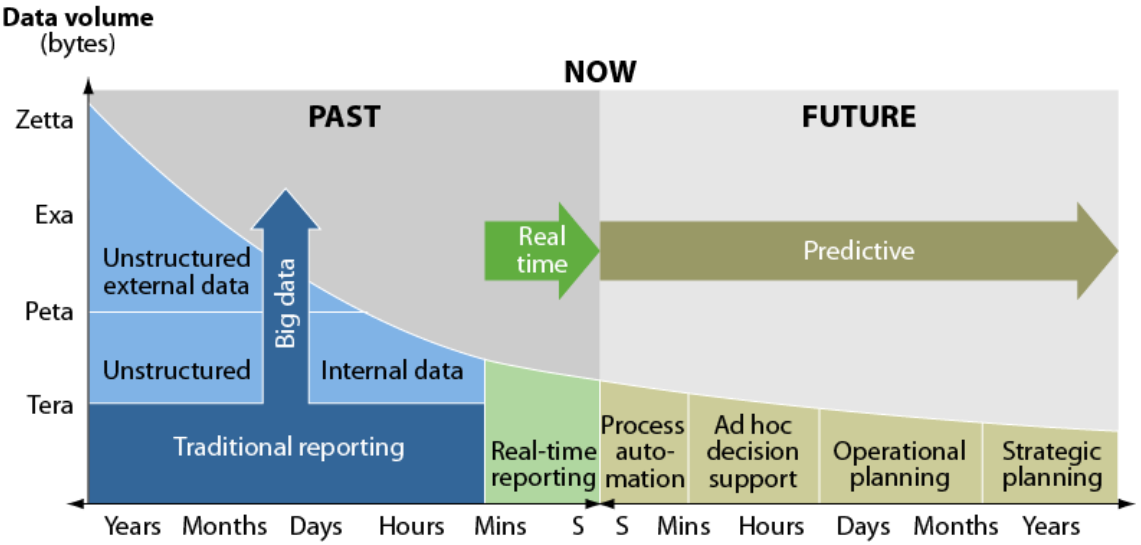
Díky využití velkých objemů dat v reálném nebo téměř reálném čase mohou společnosti získávat nové poznatky a dělat předpovědi o chování zákazníků a o celkovém chování trhu. Nicméně k získání přínosů, kterých Big Data nabízí, je třeba zavést nové nástroje a přijmout nové metody zpracování dat:

Objem (Volume): Tradiční nástroje nejsou stavěny pro zpracování a analýzu miliard záznamů. S tradičními nástroji trvá sběr dat do datového skladu nebo data martu obvykle hodiny, než je možné data analyzovat k vytvoření modelů, zjištění a předpovědí. Provádění kontextové analýzy na velkém objemu dat v minutách nebo sekundách, na základě činnosti zákazníka uskutečněné během posledních několika minut, vyžaduje zavedení nových nástrojů pro analýzu dat.

Rychlost (Velocity): Většina platforem pro datové sklady dnes provádí historickou analýzu na základě minulých údajů. Nicméně neumožňují analýzu v reálném čase, kterou společnosti potřebují pro zpracování velkého množství informací vytvářených vysokou rychlostí. Tato analýza vyžaduje schopnost rychle zpracovat a analyzovat data pomocí nástrojů, které mohou poskytnout kontextovou analýzu v reálném čase.

Různorodost (Variety): V minulosti byla většina dat strukturovaná a byla uložena v relačních tabulkách, které se mohly snadno analyzovat a zpracovávat. Dnes je velké množství dat nestrukturovaných: blogy, tweety, videa, audia, e-maily, příspěvky na Facebooku, LinkedIn, diskuzní fóra, záznamy v rámci zákaznického servisu nebo prodeje aplikací a tak dále. Tato nová data musí být rychle analyzována ke zjištění pozitivní nebo negativní nálady zákazníků a dále být prezentována ve strukturované podobě, ve které mohou být data použita k získání přehledu a k tvorbě prediktivních modelů.

S novým obdobím internetu se tedy otevírá prostor pro oborníky, kteří umí pracovat s daty. Více a více strojů připojených k síti bude generovat více a více různorodých dat, jež bude nutné umět skládat do sebe a vyhodnocovat je. Prediktivní analytika bude obrovsky důležitá a lukrativní obor. Jak je vidět na obrázku č. 3 další směr vývoje je závislý především na odhadu budoucího vývoje.



Obrázek 10 - Big data a jejich analýza v čase. Zdroj: (Alderton, 2013)

3.2 Bezpečnost získávání dat

Svět plný senzorů, čidel a dalších nových navzájem propojených přístrojů s sebou ale logicky přináší problém bezpečnosti. Vše, co je připojeno k internetu, je teoreticky napadnutelné. Bezpečnostní faktory jsou charakterizovány třemi směry.

Utajení dat - Ochrana důvěrnosti údajů představuje zásadní problém v oblasti internetu věcí. Smyslem této oblasti je vytvoření záruku, že pouze oprávněné osoby mohou přistupovat a měnit konkrétní data. V této oblasti je především nutné se zaměřit na:

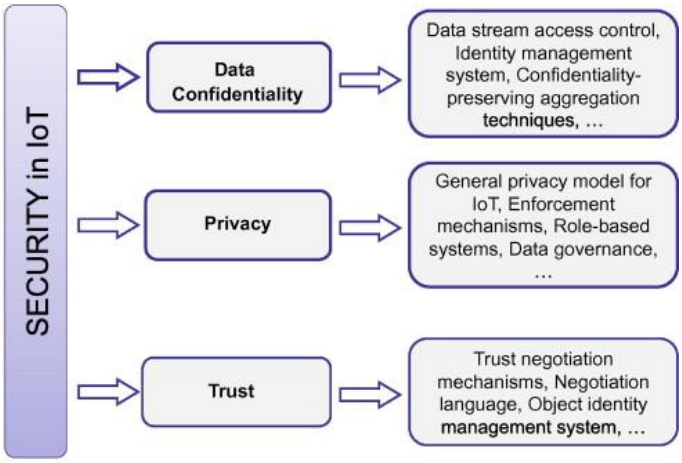
- Definování vhodných mechanismů pro kontrolu přístupu k datovým zdrojům, kterí jsou generovány zařízeními v rámci internetu věcí.
- Definování vhodného dotazovacího jazyka pro získání požadované informace ze zdroje dat.
- Definice vhodného systému inteligentního rozpoznávání objektů pro správu identit.

Ochrana osobních údajů - definuje pravidla, podle nichž mohou být údaje, vztahují se k jednotlivým uživatelům zpřístupněny. Mezi hlavní důvody, proč je ochrana osobních údajů považováno za fundamentální faktor rozvoje IoT, je souvislost s typy zařízení a ekosystémy, kterou jsou na principu IoT využívány. Hlavní roli hraje schopnost utajení dat, které byly získány např. geolokací nebo souvisí se zdravotním stavem člověka.

Důvěryhodnost dat - je používána v mnoha různých souvislostech a s různými významy. V rámci IoT je nutné se zaměřit na schopnost ověření získaných dat a jejich pravost. Mezi nejdůležitější faktory patří:

- Zavedení jednoduchého jazyka podporující sémantickou interoperabilitu požadavků internetu věcí a ověření získaných dat.
- Definování mechanismů důvěry na základě řízení přístupu k datovým tokům senzorů a objektů.
- Rozvoj vhodného řízení a správy objektů, jejich identifikace a ověření v rámci systému IoT.

Otázky v rámci bezpečnosti jsou graficky shrnuty na obrázku číslo. 4, jak je vidět níže.



Obrázek 11 - Schéma bezpečnosti v rámci IoT. Zdroj: (Miorandi, 2012)

4 Závěr

I přesto, že Internet věcí není v žádném případě nový koncept, předpokládá se, že v roce 2013 dosáhne bodu zvratu, při rychlém nárůstu nových domácností a podnikových uživatelů. Jak uvádí studie Forrester Research a Zebra Technologies (Lund, 2013), bylo zjištěno, že 53% firem plánují zavést nějakou podobu internetu věcí nebo souvisejících technologií v průběhu příštích 24 měsíců. Klíčové mají být oblasti jako obsluha dodavatelského řetězce (automatizace výroby, balení, dopravy a tak dále), produktivita zaměstnanců (nová koncová zařízení a ovládání strojů), inovace či způsob využití majetku.

Podle zprávy společnosti Gartner (McGehee, 2013), internet věcí je součástí našeho světa a očekává se nárůst na více než 30 miliard připojených strojů, budov, senzorů a předmětů. Tyto objektu budou generovat obrovské množství dat, které mají být přeměněny do znalostí a informací. Získané informace budou sloužit pro větší zabezpečení a efektivnější využití implementovaných technologií v návaznosti na další potřeby aplikací a přístrojů.

BYOD je vzrůstajícím trendem a brzy se promění v BYID (z anglického Bring Your ID). To znamená, že zaměstnanci budou moci pracovat na jakémkoli zařízení. Stačí se přihlásit pod správným heslem, pracovní plocha bude dostupná odkudkoli. O roce 2013 se všeobecně hovoří jako o zlomovém roku pro otevřené přijetí IoT. Inovace softwarových řešení dosahuje svého maxima především v oblasti napojení zařízení na internet. Propojení

s proprietárním hardware zvedá novou vlnu inovací napříč všemi odvětvími – od zdravotnictví, přes průmysl až po samotné uživatele těchto zařízení. Využití dat z takto napojených zařízení je stále ještě na počátku a čeká na nové přístupy a metody zpracování dat v reálném čase.

Pro firmy je nyní doba, kdy se na několik let dopředu jasně stanovují pravidla a směr dalšího vývoj a směřování. Na tuto dobu je nutné reagovat velmi flexibilně a prakticky online realizovat příslušné kroky a změny v podnikové infrastruktuře a nabízených produktech a službách.

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WHAT IS HIDDEN IN THE CLOUDS FOR ALGORITHM DEVELOPMENT TEACHING

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ABSTRACT

The fundamentals of algorithms have been taught for many years at the Faculty of Economics, Technical University of Ostrava in the subject Informatics B in the first year of the bachelor study. Traditionally flowcharts are used for this purpose. This article points out the possibilities of alternative approaches to algorithm development teaching that are available in the context of cloud computing, respectively the distribution model Software as a Service. The article focuses on the traditional approach to algorithm development teaching, but it also outlines new possible directions. The advantages and disadvantages for alternative approaches to algorithm development teaching are described.

KEYWORDS:

Algorithm Development, Cloud Computing, Flow Chart, Programming Language, Integrated Development Environment.

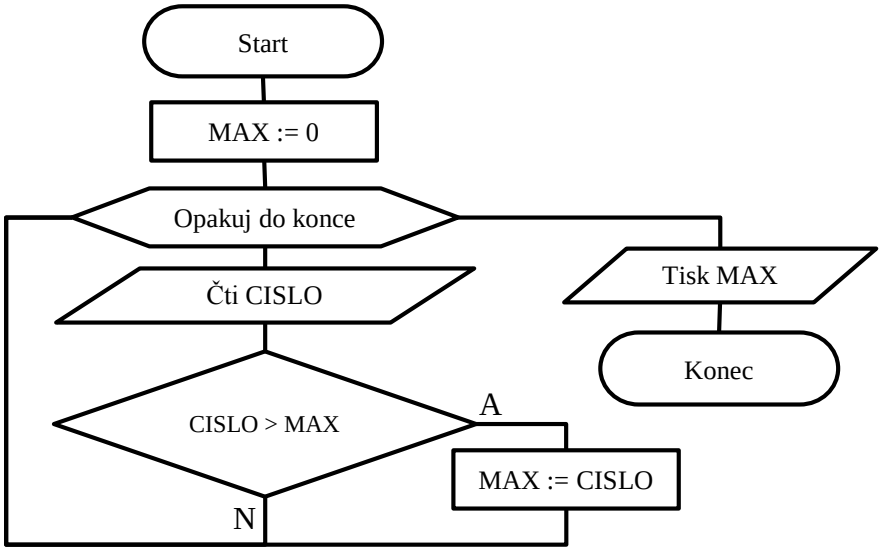
1 Úvod

Základy algoritmizace jsou již dlouhá léta vyučovány na Ekonomické fakultě VŠB-TU Ostrava v rámci celofakultního předmětu Informatika B v 1. ročníku bakalářského studia. Výuka sleduje dva hlavní cíle rozvoje kompetencí studentů. Tímto cílem je jednak posílit schopnost analyzovat a systémově řešit problém, určitou situaci. Tato cesta dále vede ke schopnosti analyzovat procesy probíhající v ekonomických subjektech. Druhým cílem je pak seznámit studenty se základními principy algoritmizace jako základním kamenem tvorby programů a softwaru obecně. Tento směr přispívá ke schopnosti konzultovat a analyzovat užití softwaru, diskutovat jejich fungování. Je nutno podotknout, že pro studenty Ekonomické fakulty plynou z výše uvedených kompetencí mnohé výhody, které mohou zužitkovat ve svém profesním životě navzdory tomu, že nestudují informatiku jako takovou, ale ekonomii. Přítomnost informačních technologií a jejich provázanost na fungování firem a institucí je na takové úrovní, že jakákoliv znalost principů fungování IS/IT nástrojů je přínosná.

K výuce algoritmizace jsou tradičně využívány vývojové diagramy. Tyto diagramy, které se používají již téměř sto let a vznikly jako podpora řízené procesů, jsou dle našeho názoru jednoduchou a logickou cestou znázornění postupu, procesu (algoritmů). V dřívějších dobách se tyto vývojové diagramy ještě přepisovaly do programovacího jazyka Pascal. Výuka programovacího jazyka Pascal však byla asi před 10 lety zrušena a to hlavně z důvodu morální zastaralosti tohoto programovacího jazyka. Přepis do konkrétního jazyka představoval také potřebu znalosti základní syntaxe, což je v kontrastu s uvedenými cíli. Na druhou stranu metody kreslení vývojových diagramů pomocí „tužky a papíru“ znemožňuje ověření správnosti nakresleného algoritmu jeho provedením. Praktická demonstrace zapsaného algoritmu je ale velice důležitá, protože samotný algoritmus zapsaný vývojovým diagramem je příliš abstraktní na to, aby student zcela pochopil význam příkazů, které v takto zapsaném algoritmu použil. Výsledkem je odtržení studenta od možnosti kontroly a znemožnění sledování průběhu realizace navrženého řešení (krokování s možnou korekcí).

Jelikož není cílem článku diskuse nad vhodností užití vývojových diagramů, ale přiblížení možnosti alternativních přístupů spojených s cloudovým řešením, zaměříme se nyní přímo na tuto oblast. Cloud computing a v tomto případě hlavně distribuční model SaaS (Software as a Service) v dnešní době nabízí nepřeberné množství různých aplikací, které jsou dostupné k okamžitému použití bez nutností jakékoliv instalace, a některé z nich by mohly být více než vhodné také pro výuku algoritmizace.

V následujících kapitolách bude popsáno několik způsobů, jak lze některé z cloud computingových aplikací při výuce algoritmizace využít. Pro lepší pochopení bude vše demonstrováno na jednoduchém příkladu nalezení jednoho extrému (maxima) v řadě čísel, viz vývojový diagram na obrázku 1.



Obrázek 12 Vývojový diagram demonstračního příkladu

Další typy příkladů používaných pro výuku algoritmizace na Ekonomické fakultě VŠB-TU Ostrava lze najít v Kalužová a Vlček (2012).

2 Google Apps Spreadsheet

Novák (2012) ve svém článku Využití Microsoft Excelu při výuce vývojových diagramů popisuje možnosti, výhody a nevýhody použití Microsoft Excelu při výuce algoritmizace. V cloudu existuje několik alternativních tabulkových kalkulátorů, které by bylo možno pro daný účel využít při zachování stejných možností, výhod i nevýhod. Ty nejvýznamnější tabulkové kalkulátory jsou pravděpodobně:

- Microsoft Excel Web App a
- Google Apps Spreadsheet.

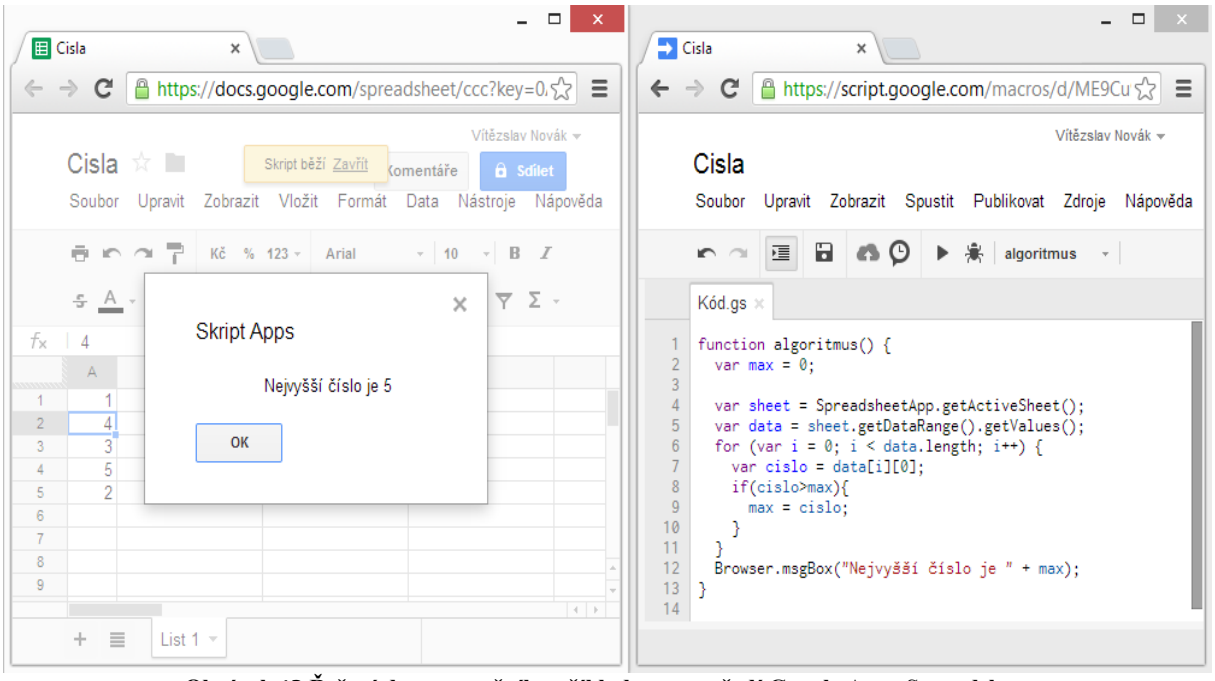
Z hlediska běžného použití jsou tyto tabulkové kalkulátory velmi podobné a s velmi podobnou funkcionalitou, takže je těžké označit jeden z nich jako lepší nebo horší. Z hlediska použití těchto tabulkových kalkulátorů jako prostředku pro výuku algoritmizace v sobě ale skrývá Microsoft Excel Web App jednu zásadní nevýhodu – nelze v něm psát skripty (obdoba maker v plnohodnotném Microsoft Excelu). Sešity v Google Apps Spreadsheet lze pomocí skriptů automatizovat (skripty jsou programovány v programovacím jazyce Google Apps Script, což je programovací jazyk JavaScript rozšířený o použití v prostředí Google Apps (Google, 2013)), takže jej lze použít ve smyslu článku Novák (2012). Ten také vyjmenovává při použití Microsoft Excelu při výuce algoritmizace následující výhody a nevýhody.

Pokusme se je tedy stručně shrnout a srovnat s použitím Google Apps Spreadsheetu při výuce algoritmizace, viz následující tabulka 1.

Tabulka 1 Srovnání vybraných výhod a nevýhod Microsoft Excelu a Google Apps Spreadsheetu

Microsoft Excel	Google Apps Spreadsheet
+ Vývojové prostředí jazyka VBA je součástí Excelu, nic není nutno instalovat. Je relativně jednoduché.	+ Vývojové prostředí jazyka Google Apps Script je součástí Google Apps Spreadsheetu. Je relativně jednoduché.
+ Základní řídící příkazy jazyka VBA (*If Then Else, For Next* a další) mají relativně jednoduchou syntaxi.	+ Základní řídící příkazy jazyka JavaScript (*if else, for* a další) mají relativně jednoduchou syntaxi.
+ Pole v jazyce VBA mohou být indexována od indexu 1, což odpovídá způsobu použití polí ve výuce algoritmizace na EkF.	- Pole v jazyce JavaScript jsou vždy indexována od indexu 0, což neodpovídá způsobu použití polí ve výuce algoritmizace na EkF.
- V jazyce VBA je index pole zapisován do kulatých závorek, což neodpovídá způsobu použití polí ve výuce algoritmizace na EkF.	+ V jazyce JavaScript je index pole zapisován do hranatých závorek, což odpovídá způsobu použití polí ve výuce algoritmizace na EkF.
+ Proměnným v jazyce VBA není nutno přiřazovat explicitně datový typ, což zjednodušuje použití jazyka.	+ Proměnným v jazyce JavaScript není možné přiřazovat explicitně datový typ, což zjednodušuje použití jazyka.
- Excel je placený software.	+ Google Apps Spreadsheet je dostupný zdarma.

Možné řešení demonstračního příkladu v prostředí Google Apps Spreadsheet by tedy mohlo vypadat například nějak takto (viz obrázek 2).



Obrázek 13 Řešení demonstračního příkladu v prostředí Google Apps Spreadsheet

Jak lze vidět v kódu Google Apps Scriptu na obrázku 2, pokud jsou cvičná data uložena přímo v sešitu tabulkového kalkulátoru, je nutno se na tento sešit a jeho oblast dat odkázat pomocí speciálních objektů Google Apps Scriptu, což ale může zbytečně odvádět pozornost

studentů od samotného jádra algoritmu. Tento problém lze ale řešit podobně jako v Novák (2012) vytvořením pomocných funkcí v Google Apps Scriptu, které zjednoduší přístup k datům uložených v sešitu Google Apps Spreadsheetu.

3 Integrovaná vývojová prostředí

Vývojové prostředí Google Apps Scriptu však není v cloudu jediným dostupným vývojovým prostředím. Pokud nebudeme vyžadovat uložení cvičných dat v nějakém tabulkovém kalkulátoru, ale budeme vyžadovat pouze možnost zápisu algoritmu v některém z dostupných programovacích jazyků, máme k dispozici dnes již velmi mnoho vývojových prostředí počínaje jednoduchými prostředími určenými pro zápis a běh pouze jednoduchých programů (např. ideone.com), až po vývojová prostředí, z nichž některé se dnes již svou funkcionalitou začínají přibližovat klasickým vývojovým prostředím instalovaným na desktopech (např. codenvy.com nebo www.coderun.com). Protože jsou tato IDE dostupná na webu, slouží zejména pro tvůrce webových stránek, čili pro editaci HTML, JavaScriptu a CSS. Zejména ale JavaScript by ale bylo možno pro výuku algoritmizace použít.

Pro výuku algoritmizace se jeví jako jeden z nejvhodnějších vývojových prostředí ideone.com. Podle IDEONE.COM (2013) je ideone.com nejen prostředí pro tvorbu programovacího kódu za účelem jeho sdílení na webu, ale je to také online mini integrované vývojové prostředí a ladící nástroj. Pro výuku algoritmizace je toto prostředí vhodné zejména z těchto důvodů:

- jednoduchost – není nutná žádná registrace nebo konfigurace, není nutné vytvářet žádné projekty atd. Stačí pouze zapsat programový kód algoritmu do určeného textového pole a spustit.
- možnost výběru programovacího jazyka z více než 40 programovacích jazyků,
- možnost zadání vstupních dat,
- možnost sdílení kódu.

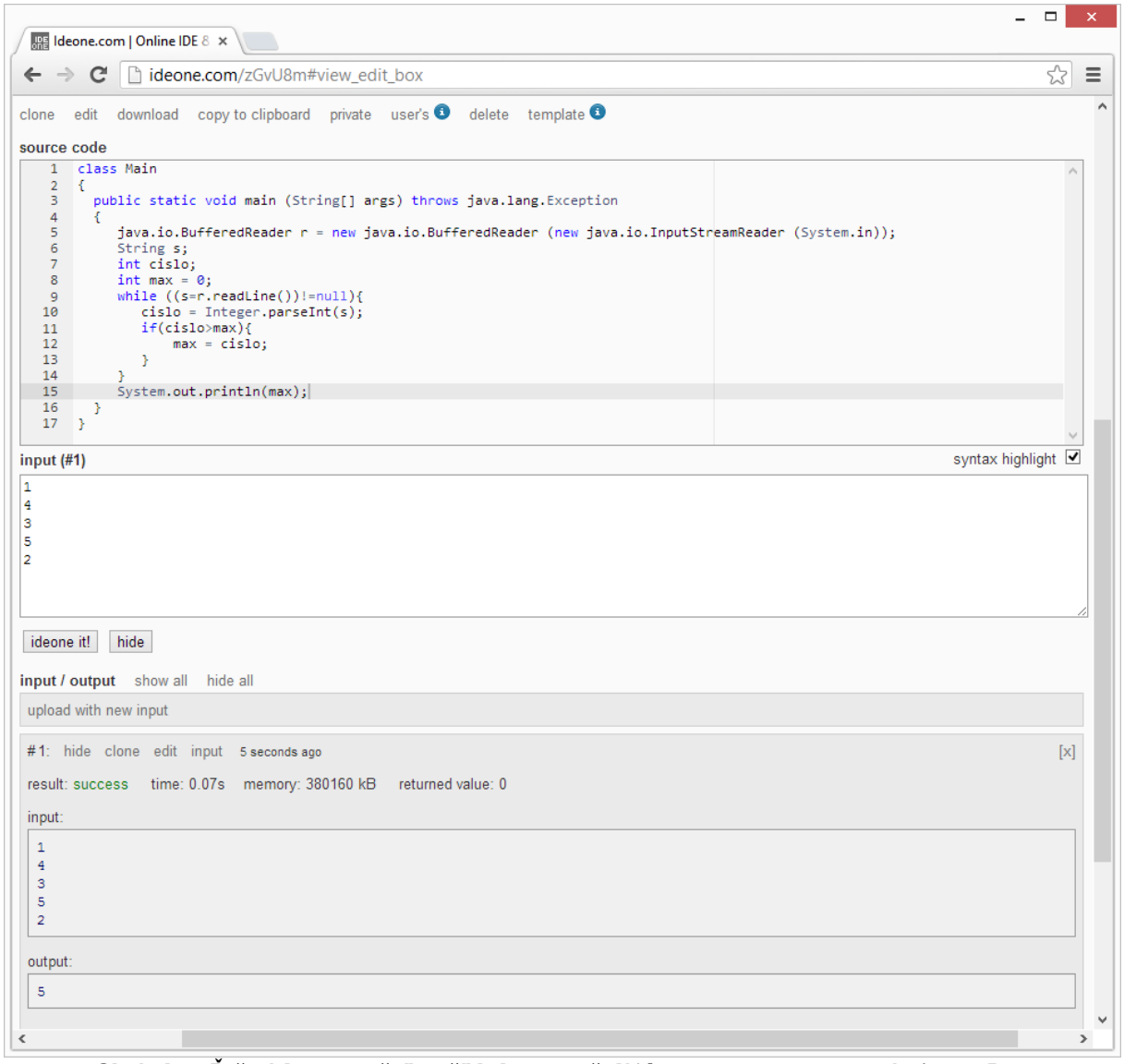
Možné řešení demonstračního příkladu v prostředí ideone.com v programovacím jazyce Java pak vypadá takto (viz obrázek 3).

4 Visuální programovací jazyky

Velkou nevýhodou používání integrovaných vývojových prostředí klasických programovacích jazyků jako jsou Java nebo JavaScript pro výuku algoritmizace je nutnost naučit studenty alespoň základy syntaxe těchto programovacích jazyků. Tato nutnost ale odpadá v případě použití některého z visuálních programovacích jazyků. Podle Lučaniče a Fabka (2011) je cílem visuálních programovacích jazyků (Visual Programming Language) přesunout část práce programátora na IDE tak, aby se programátor mohl více soustředit na logiku algoritmu než na syntaxi samotného programovacího jazyka.

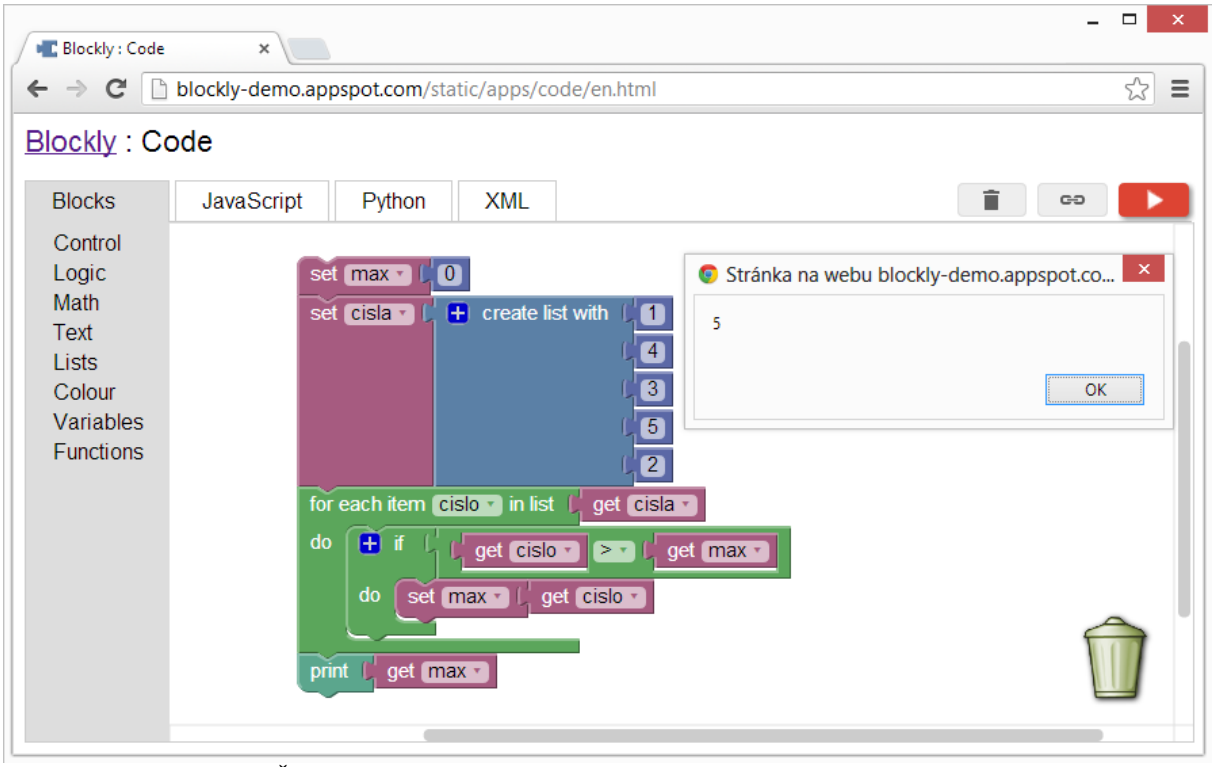
Mnohé z visuálních programovacích jazyků se nachází také v cloudu. Jedná se např. Blockly (https://code.google.com/p/blockly/), Scratch (http://scratch.mit.edu/) nebo Waterbear (http://waterbearlang.com/). Princip těchto jazyků je velmi podobný: sestavit program pomocí dílků skládačky typu puzzle a to bez znalosti konkrétního programovacího jazyka. Pro výuku algoritmizace se jeví jako nejvhodnější visuální programovací jazyk Blockly. Podle Blockly (2013) je Blockly na webu založený grafický programovací jazyk, kde uživatelé mohou pomocí tažení bloků vytvořit aplikaci bez nutnosti psaní. Pro výuku algoritmizace je vhodný nejen proto, že obsahuje všechny potřebné elementy používané při výuce algoritmizace, ale výsledný program je Blockly také schopen přeložit do programovacích jazyků JavaScript nebo Python a navíc tento výsledný program umožňuje

vyexportovat a editovat pomocí XML, což umožňuje přichystat do výuky např. vstupní data nebo některé části algoritmu.



Obrázek 14 Řešení demonstračního příkladu v prostředí ideone.com v programovacím jazyce Java

Možné řešení demonstračního příkladu ve visuálním programovacím jazyce Blockly pak vypadá takto (viz obrázek 4).



Obrázek 15 Řešení demonstračního příkladu ve visuálním programovacím jazyce Blockly

5 Závěr

V tomto článku byly uvedeny základní směry, které umožňují výuku základů algoritmizace: využití tabulkových kalkulátorů v distribučním modelu SaaS, využití integrovaných vývojových prostředí nebo vizuálních programovacích jazyků. Je vidět, že lze nalézt alternativní cesty k výuce algoritmizace pro studenty, u kterých není cílem zajistit znalosti programování, ale jde pouze o demonstraci principů a fungování jednoduchých algoritmů. Volba vhodného prostředku by se pak měla odvíjet od konkrétních potřeb a výukových cílů. Tyto alternativy v současnosti využívají možností, které vychází z technologického potenciálu (v tomto smyslu cloud computingu).

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THE POSSIBILITY OF USING THE VLE MOODLE TO SUPPORT CLIL

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ABSTRACT

The paper summarises Authors' experience in teaching both content and language with support of the VLE Moodle. First, the results of a survey conducted among multinational students of Cracow University of Economics that concerned their perception of learning in a virtual environment are presented. Next, the best practices for supporting CLIL in blended-learning courses are proposed.

KEYWORDS

Blended learning course, e-learning, non-native language, CLIL

1 Introduction

In view of growing students mobility in the recent decades, the issue of content and language integrated learning (CLIL) has become important and focused attention of many researchers (e.g. [1], [4]). This dual approach to learning has many apparent benefits in the form of improving students' language proficiency and preparing them for functioning in a multilingual environment. However, it should be noted that it often comes as a natural necessity resulted from people migration and changing of their language environment.

This paper is an extension of the authors' previous work concerning content and language integrated learning. Continuing investigation of students' background and their expectations [3], the paper is focused on exploring technical aspect of possible course organisation improvement in order to stimulate the process of effective learning content and language. Particularly, the authors would like to address the following research question: how effectively use the VLE Moodle to support content and language learning?

In the section 2 the results of a survey conducted among multilingual students of Cracow University of Economics are presented. Next, the best practices of courses construction that support CLIL are proposed and discussed. Finally, the main conclusions are drawn and the future work is outlined.

2 Survey

2.1 Background

The survey was conducted among students of Cracow University of Economics that study in a non-native language during the winter semester of the academic year 2012/2013. They participated in Electronic Data Interchange module that was delivered in Polish and English, and Information Technology and Programming Workshop modules, both taught in Polish. All modules were delivered in a blended learning form with an e-learning part of the curriculum supported by the Virtual Learning Environment Moodle (VLE) [2].

The population of students was diversified as it encompasses students whose native language was Polish, Ukrainian, Russian, English, Arabic, and Hindustani. In total 52

students responded to the survey. It should be noted that respondents decided to study in a foreign language mainly in order to enhance their employment opportunities but also to improve their language skills and be able to use a foreign language on a daily basis. Their language skills were highly diversified and some of them needed to search for materials in their native language to help them to understand the module content.

When asked what aspect of studies they found the most difficult, they reported problems in understanding content in other than their native language. It can be explained by too low initial level of language and insufficient background knowledge of the field they studied. However, more that 80 percent of respondents noticed improvement of their language skills since they started studying in a foreign language. In order to enhance this improvement and support learning content most of them opted for making the available resources more interactive, preparing more resources for studying content, creating the environment where students can share their experience and find support, and providing more opportunities for student-teacher interaction. Further, the preliminary results of research also revealed that they needed language support in the form of dictionaries with relevant technical vocabulary. The details of the respondent structure as well as the complete list of the survey questions can be found in [3].

2.2 Data Analysis

Most students were satisfied with the use of the VLE Moodle and only 4 percent expressed their total dissatisfaction (Figure 1). Besides, they found it rather easy to navigate (Figure 2), despite the fact that 20 percent of them felt that the training they received was insufficient.

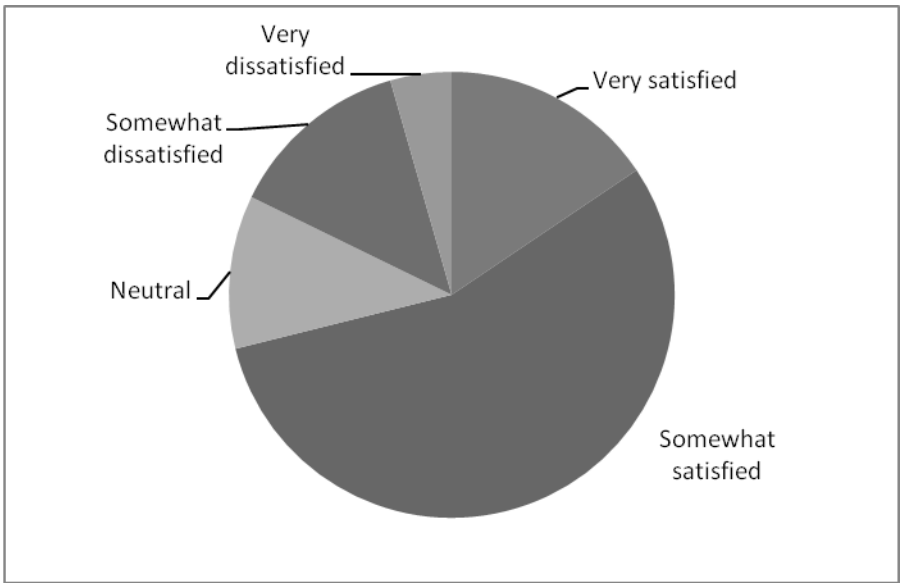

Figure 19 Students' satisfaction with the use of the VLE Moodle

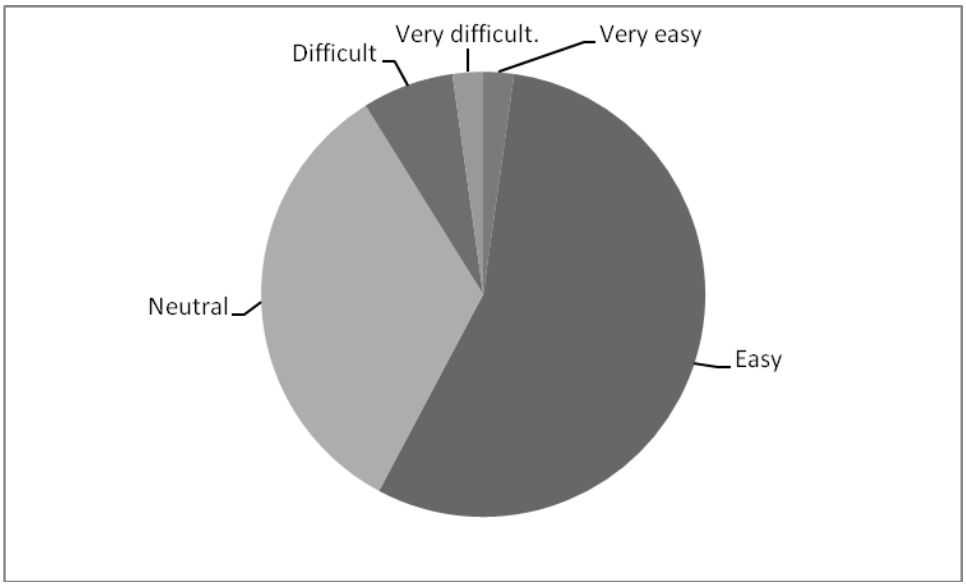

Figure 20 Difficulty of perception (use and navigation) of the VLE Moodle

The purpose of the Moodle usage was depicted in Figure 3. Little more than half of students downloaded lessons and did assignments several times a week. It is surprising that almost 30 percent of them checked their grades on a daily basis. What is more, they rather rarely communicated with lecturers as only 7% did that daily, 27% monthly, and 13% never communicated.

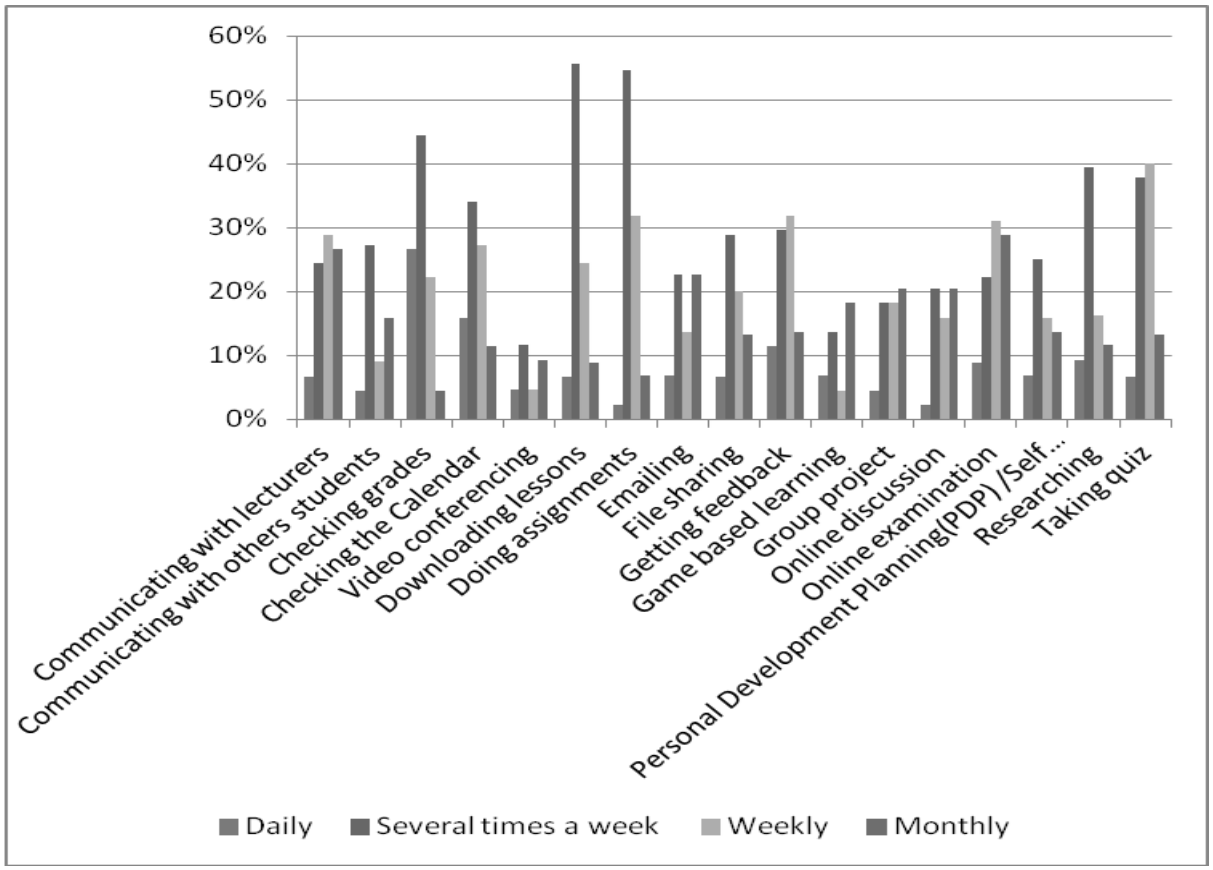

Figure 21 The purpose of VLE Moodle usage

Investigating the usefulness of Moodle resources, the following tools were taken into account:

- Assignments – to submit any digital content (files), to receive grades and comments on uploaded files and assignments,
- Chat - to have a real-time synchronous discussion,
- Choice – to answer a question from a choice of multiple responses specified by a teacher,
- Database - to create, maintain and search a bank of record entries about any conceivable topic,
- External tool - to access and interact with learning resources or take part in activities on other web sites,
- Feedback – to give feedback about the module,
- Forum - to have asynchronous discussions, exchange ideas by posting comments,
- Glossary - to create and maintain a list of definitions, like a dictionary,
- Lesson - for studying content in flexible ways,
- Quiz – to take part in a quiz tests which may be automatically marked,
- Survey - to help teachers learn about their classes and reflect on their own teaching,
- Wiki - to add or edit a collection of web pages, creating content as an individual or a group,
- Blogs - for self-expression and communicating with other students and lecturers,
- Workshop – for peer assessment.

All of the Moodle tools were found useful but respondents perceived online assignments and quizzes as the most useful (Table 1) and besides they would prefer them for online learning (Table 2).

Table 2 Usefulness of the online tools when studying content and learning a foreign language

Answer Options	The most useful	More useful	Useful	Less useful	The least useful
Assignments	21%	23%	47%	5%	5%
Quiz	20%	34%	39%	5%	2%
Lesson	12%	30%	40%	14%	5%
External tool	11%	16%	50%	16%	7%
Feedback	11%	27%	45%	11%	5%
Chat	9%	33%	19%	30%	9%
Survey	9%	30%	41%	16%	5%
Workshop	9%	27%	48%	7%	9%
Glossary	9%	20%	51%	16%	4%
Database	7%	23%	44%	19%	7%
Choice	7%	30%	55%	7%	2%
Wiki	5%	20%	45%	20%	9%
Forum	4%	36%	51%	7%	2%
Blogs	2%	33%	27%	20%	18%

Table 3 Respondents preference of the online tools for collaborative learning

Answer Options	Response Percent
Quiz	64%
Assignments	56%
Forum	38%
Lesson	36%
Workshop	29%
Choice	27%
Chat	24%
Feedback	24%
Database	22%
Blogs	22%
External tool	20%
Glossary	20%
Survey	18%
Wiki	16%

2.3 Discussion

The results of survey suggest that students found the VLE Moodle easy to navigate and they are rather satisfied with the use of this platform. However, there are also some unexpected and additional results that follow the close investigation of student's usage of the Moodle tools. Namely, relatively high percent of students was not involved in weekly assignments and was not in regular contact with lecturers. These results indicate that some measures should be taken to motivate students to regular participation in course activities and encouraging them to profit from lecturers' assistance.

3 The Proposition of best practices of designing blended-learning modules

As of the academic year 2010/2011, all newly created course materials as well as those that had already been created before were modified. The changes were made in order to meet expectations of an increasing number of international students starting their studies at the Cracow University of Economics. The purposes of these changes were the following:

- increase the effectiveness of teaching content among both foreign and Polish students,
- allowing simultaneous learning both the content and a foreign language,
- learning technical vocabulary in a language other than their mother tongue,
- promotion of Polish language among foreign students.

Modifications have been subjected to both the materials used during the lectures and e-learning courses available at the university e-learning platform Moodle, used primarily during the workshops. In addition, students' language classes were adapted to allow them to quickly absorb the difficult technical issues delivered in a foreign language.

On the basis of previous teaching experience and the survey conducted among students the Authors formulated the set of best practices for preparing courses that facilitate learning both content and language. These best practices concern lectures, workshops, communication with students and language lessons. They will be presented in the next sections.

3.1 Lectures

Due to the specificity nature of the modules, lectures are usually conducted in the traditional form, i.e. they are held in the university classrooms. There are separate classes for students studying in Polish and foreign languages, which is in accordance with the curriculum. On the basis of observations and opinions expressed by the students, the following solutions can be suggested:

Slides preparation. The separate materials (mainly slides) for each of the taught languages should be developed. This will increase the readability of the materials presented during lectures. Due to the limited space on the slide, the duplication of the content in multiple languages would lead to a reduction in clarity.

Slides publication. It is important to provide materials (slides) prepared in many languages to all interested students (both Polish and foreign). All materials should be published prior to the lectures giving students the opportunity to familiarise themselves with the content and vocabulary in a foreign language.

Participation in lectures in Polish. It is suggested to enable attendance at the lectures taught in Polish to students studying in foreign languages. This action will contribute to the promotion of Polish language among foreign students.

Participation in lectures in a foreign language. It is suggested to enable attendance at lectures conducted in a foreign language to students studying in Polish. This gives the Polish students the opportunity to learn vocabulary faster. It should be noted that the opportunity to participate in lectures in Polish by foreign students leads to faster assimilation with their Polish fellow students. Social activities also improve fluency in a foreign language.

3.2 Workshops

Course organisation. It is suggested to use the e-learning platform to conduct a part of classes in the form of distant learning. E-learning platform can also give a significant support for the implementation of activities in the traditional form. It is recommended:

- creating an integrated common course on the e-learning platform for both Polish and foreign students,
- designing an e-learning course in the bilingual form (Figure 3).
- Significant advantages of a common Moodle course for all students, regardless of nationality and language of the classes are the following:
- faster integration of students,
- reduced time cost of a course update.

It should be noted that students are able to choose the user interface language of the e-learning Moodle platform. As a result, menus and system messages are displayed in the language preferred by the student.

As the classes are held in the form of blended learning, it is important that the traditional and e-learning types of course activities are explicitly highlighted. Figure 4 shows an example of the structure of an e-learning course in which the activities carried out in the traditional way are highlighted brown, while those that are conducted in the form of e-learning are marked in green.

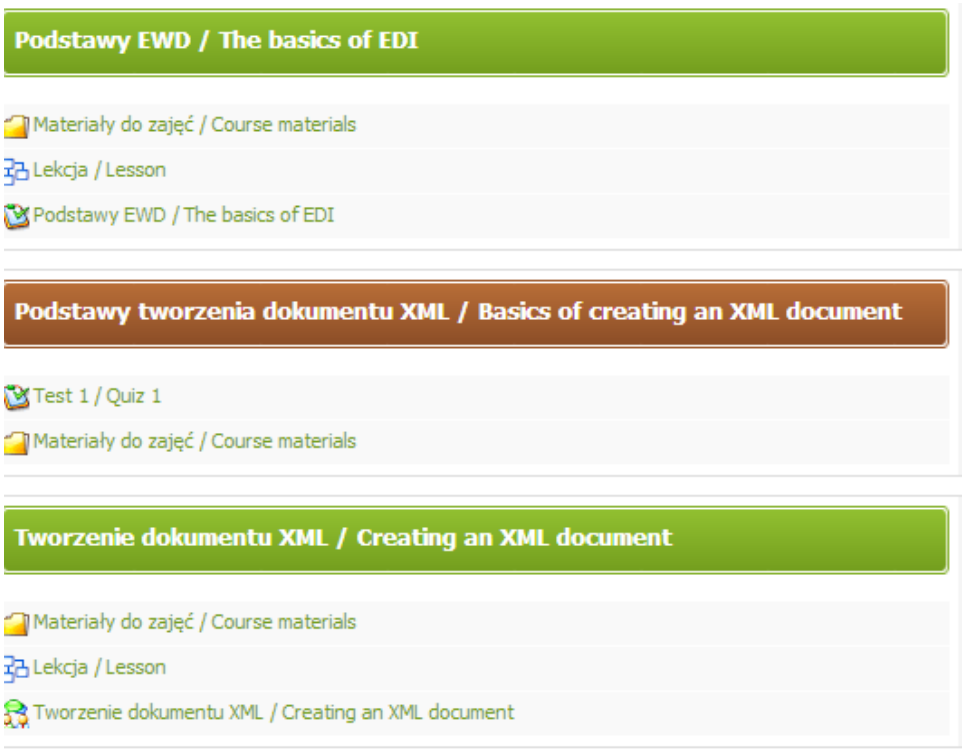

Figure 22 Bilingual e-learning course structure created on the Moodle e-learning platform

For greater clarity, it is recommended to separate all the multilingual titles in the course by using a delimiter (a slash sign). However, as practice shows, the course structure created in this way is clear and understandable to all students.

E-learning lessons. The lesson is one of the most complex of resources available on the e-learning platform. It facilitates the development of the material in the form of text, graphics, sound, and checking students' progress using questions. In the case of a large volume of individual lesson pages, it is recommended creating separate blocks of text for each language instead of translating individual sentences. Created blocks of text can be separated by using a horizontal line.

Checking students' knowledge. The e-learning platform provides a set of tools for checking students' knowledge. The most frequently used are quizzed and practical assignments.

Quizzes include a set of questions about the topics covered during the lectures. For each question there are four answers of which at least one is correct. It is suggested that both questions and the related answers be available in both Polish and foreign language. Due to the limitations of the e-learning platform, the content of the questions and answers in different languages can be separated by using a delimiter (Figure 5). This works well in practice, allowing the simultaneous observation of questions and answers in multiple languages, leading to a rapid vocabulary memorising.

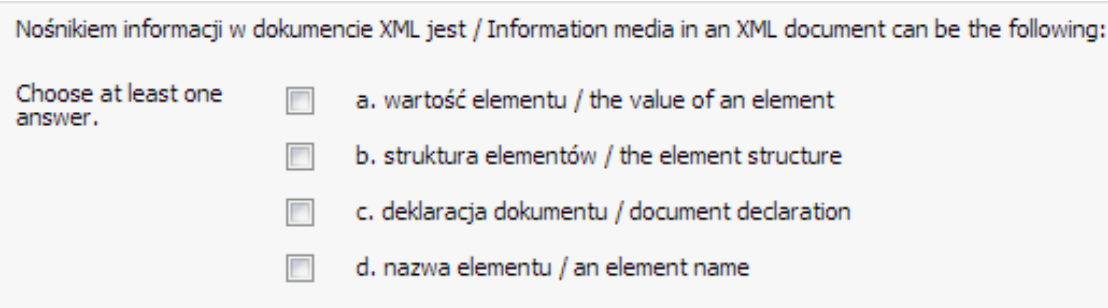

Figure 23 An example of a bilingual test question and possible answers

Practical assignments usually rely on the execution of instructions, and then submitting the results (files) on the e-learning platform. In the case of large volume of the text assignment it is desirable to create it as separate blocks of text for each language. Additionally, if the assignment contains an extra components (such as files), they should be created only in English.

3.3 Communication with students

An important part of the teaching process is communication with students. It is recommended using for this purpose means of electronic communication, such as a forum where students can post questions to their teacher, share their comments and exchange views on the topics discussed during the course. To increase the effectiveness of the simultaneous study of the subject and language, a common forum for both Polish and foreign students should be created.

It should be ensured that threads of discussion are conducted in the language of the first post in this thread. This rule encourages students to overcome the language barrier. As practice shows, the students, after an initial shyness at the beginning of the semester, try to take part in the discussion, and learn their second language simultaneously.

3.4 Language classes

One of the important support for students in understanding the module topics are compulsory language classes.

Language class content. It is essential to ensure that the language classes are conducted in close cooperation with the module topics.

Phrase bank. A support of language classes with created phrase bank based on the vocabulary module is strongly recommended.

4 Conclusion

The paper presents the results of a survey conducted among multinational students of Cracow University of Economics, Poland. All of them studied in a language that was not their native (Polish or English) thus they need to learn content as well as overcome some language deficiencies. The survey results showed that they found the VLE Moodle easy to use and helpful in adjusting to learning in a foreign language.

On the basis of the survey results and Authors' *a few years* of prior *experience* in teaching multinational students the collection of best practices was developed that concerns a design of Moodle supported modules that enable both content and language learning. The best practices are formulated taking into account Polish environment but they can also be applied to other countries. As for lectures, it is recommended making available materials for all students in both Polish and English (in separate files). Further, workshops can be effectively

supported by the online bilingual course on the VLE Moodle. Course materials in both languages for all participating students should be available that will help them to familiarise themselves quickly with a foreign language and specific professional vocabulary. Communication between teachers and students is vital in the process of blended-learning and that is why particular attention should be paid to encourage students to participate in online discussions conducted mainly via forums. These forums should be also bilingual but it is suggested to follow by students the basic rule: if the discussion is started in one language that it should be continued in the same language. Additionally, online course materials should contain a dictionary with the basic terminology and some recommendation should be made to language teachers as for the vocabulary that students need to practice.

In future work Authors would like to concentrate on designing video and audio materials that could support CLIL.

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SELECTED DIRECTIONS OF VIRTUAL LEARNING ENVIRONMENTS DEVELOPMENT

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ABSTRACT:
E-learning is determined by the evolution of virtual learning environments. Opportunities offered by virtual learning environments depend on the current state of the ICTs development. The most characteristic symptoms of virtual learning environments transformation are: focusing on Web 2.0 and social media, data streaming and the dissemination of mobile devices, tools and applications, that use wireless data communication network. The purpose of this article is to depict selected trends of virtual learning environments. The focus is on trends arising from social (collaboration) and communication technology.

KEYWORDS:
E-learning, virtual learning environment, VLE, Web 2.0, social e-learning, e-portfolio, virtual worlds, webinar, m-learning

1 Introduction

E-learning is a process of continuous technological and organizational transformation. Transformations in the teaching and learning formula have had an impact on the progress and development of e-learning [10][20][28]. In fact, we deal with a new paradigm of education, in which education gains a modern form and content. Lifelong learning, education available through the ever-newer solutions for communication and data sharing, networking and global education, learning through active participation rather than through reading and repetition, education of knowledge workers – these are just some of the changes in modern education.

E-learning is strongly influenced by the development of information and communication technologies (ICT), in particular the development of Web 2.0 and mobile devices and applications [22][26]. Web 2.0 has changed the face of the Internet, allowing for self-editing of website content by Internet users. Web 2.0 is a change that transformed static Web resources into dynamic interaction and collaboration among users. Since then, even those users who do not have high technical expertise are able to write, publish and share content. As a result of Web 2.0 development new tools have appeared to share knowledge, acquire knowledge and make knowledge available, such as social networking, blogs, wikis, folksonomies, mashups, virtual spaces. E-learning based on Web 2.0 is described as the second generation of e-learning - e learning 2.0 [5][6][15].

Devices and mobile applications are another important determinant of the e-learning transformation. Miniaturization of hardware, the proliferation of mobile devices and increasingly easier access to wireless communication networks are becoming trends that seem to be getting clearer. There are more widely used mobile applications such as, inter alia, GPS, QR code, mobile payments, as well as applications that were previously only available on desktops and have been adapted for mobile electronic devices. E-learning applications are also undergoing such adaptations.

The development of ICT as well as changes in the organization of education foster the development of a virtual learning environment (VLE). The purpose of this paper is to present some directions of virtual learning environment, resulting from the technological transformations that have been outlined above.

The article is structured as follows. The introduction presents the research methodology. Then e-learning platforms and virtual learning environment are characterized along with highlighting differences between them. Here e-learning platforms are indicated as a component of a VLE. However, a virtual learning environment has been clarified as a broad term covering many technologies available. Subsequently, some of the technologies which can create a VLE have been described. The focus is on social and communication technologies of e-learning. The technologies that have been dealt with here are: social e-learning, e-portfolio, virtual worlds, webinars and m-learning.

The solutions presented in the paper may be useful for those interested in e-learning, making decisions related to the implementation of e-learning and implementing e-learning.

2 Methodology

The critical analysis of the literature has been used in the studies. There has also been applied an analysis of ICTs in terms of their adaptation to the needs of e-learning, in particular the analysis of mobile and based on Web 2.0 technologies. Additionally, e-learning platforms and selected Web 2.0 technologies and mobile electronic devices have been reviewed.

3 E-learning platforms and virtual learning environments

E-learning is typically associated with systems of LMS (Learning Management System) and LCMS (Learning Content Management System) type [3][4][9][15][16], as well as e-learning platforms that usually combine the functionality both of these systems. Examples of popular commercial e-learning platforms are: Blackboard Learning System1, Fronter2, Oracle iLearning3, Desire2Learn4, Adobe eLearning Suite5. Many platforms are distributed non-commercially, such as the most popular at Polish universities Moodle platform6 [25], ATutor7, Claroline8, OLAT9, Sakai10, Ilias11.

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3 Oracle iLearning, (http://ilearning.oracle.com), retrieved: 4 September 2013.

4 Desire2Learn, (www.desire2learn.com), retrieved: 4 September 2013.

5 Adobe eLearning Suite, (http://www.adobe.com/pl/products/elearningsuite.html), retrieved: 4 September 2013.

6 Moodle, (http://moodle.org), retrieved: 4 September 2013.

7 ATutor, (http://www.atutor.ca), retrieved: 4 September 2013.

8 Claroline, (http://www.claroline.net), retrieved: 4 September 2013.

9 OLAT, (http://www.olat.org), retrieved: 4 September 2013.

10 Sakai, (http://sakaiproject.org), retrieved: 4 September 2013.

11 Ilias, (http://www.ilias.de), retrieved: 4 September 2013.

Learning objects are an essential element of e-learning platforms. A learning object (LO) is a closed part of the training which performs certain educational tasks [15], or else it is the "*smallest chunk of content that can stand by itself as a meaningful unit of learning*" [11].

Platforms allow to store, edit and share learning objects. Fairly common practice is to place the learning objects prepared with various additional tools and ICT on learning platforms. Some of them are clearly dedicated to e-learning. It is worth to mention:

- Authoring tools (AT), as Lectora by Triviantis12 and Adobe Flash13. AT are tools used to create content for e-learning or those that are dedicated to the preparation of multimedia documents easy to publish on the web. Usually, these are the tools whose support requires considerable knowledge and skills, and no small amount of work and time;
- Rapid e-learning tools – they facilitate faster preparation for publication of learning objects than AT. Rapid e-learning tools are very often used in presentations made with popular programs such as PowerPoint and optimize them so that they are suitable for uploading onto the web [5]. Examples of such tools are: Articulate Rapid E-learning Studio Professional14 or Adobe eLearning Suite15; and
- Webcasts – movies specially prepared for uploading onto the web.

It should be noted that at present the educational process may require the use of many additional opportunities that e-learning platforms usually do not offer. Say, the opportunities offered by, for example, social networking sites, virtual worlds, global, distributed digital libraries, learning object repositories (LOR) and other resources and sources of knowledge acquisition. Thus, the functionality of an e-learning platform may not be sufficient from the point of view of modern educational process. Virtual learning environments rise to these challenges.

A virtual learning environment, as well as e-learning platforms, should be understood as a system to support the administration, organization and implementation of e-learning with the use of tools for creating educational content and online communication. VLE is a software for delivering learning materials to students via the web. These systems include assessment, student tracking, collaboration and communication tools. The virtual learning environment equipped with several features to support actual communication informally, create communities and support collaboration [6] [16] [21].

Platforms for e-learning and VLE should be clearly distinguished. The virtual learning environment is a broader concept that goes beyond the e-learning platform. VLE is not just single package solutions, but any attempt to create a unified environment for learning. Modern VLE combine multiple technologies and e-learning network locations that can be used in the educational process. Henceforth, an e-learning platform can be an important, but not the only part of the VLE. Technologies, which typically are not integrated with the e-learning platform and can constitute independent VLE or its components are:

- social technologies, such as: social e-learning, e-portfolios, virtual worlds;

12 Triviantis Lectora, (http://lectora.com), retrieved: 4 September 2013.

13 Adobe Flash, (http://www.adobe.com/pl/products/flash.html), retrieved: 4 September 2013.

14 Articulate Rapid E-learning Studio Professional, (http://www.articulate.com/products/studio.php), retrieved: 4 September 2013.

15 Adobe eLearning Suite, (http://www.adobe.com/resources/elearning), retrieved: 4 September 2013.

- communication technologies, such as: m-learning, webinars;
- learning object repository (LOR) – big repositories of learning objects;
- Internet search engines, wikis, and more.

In the following part of the paper focuses on the characteristics of the selected e-learning technologies. Considerations separated into those related to technology and social networking for communication technologies. Described successively social e-learning, e-portfolios, virtual worlds, webinars and m-learning.

4 E-learning towards social and collaborative learning

The weakness of e-learning can be participants failing to feel satisfied associated with the social need for belonging and the need for cooperation. This feature is not always mentioned by the authors of the literature. However, it was noted that the interaction and collaboration with other participants in the community means that people learn more effectively [24]. The social learning theory, which was created by Albert Bandura, has given rise to social learning. This theory says that people learn by observing the behavior of other people, their attitudes and the effects of these behaviors [2]. Popularization of Web 2.0, which resulted, inter alia, in the development of social media, has made certain aspects of social networking possible to adapt to the needs of e-learning. Such e-learning, which strongly emphasizes the social aspects is called social learning or collaborative e-learning.

Virtual communities that are formed in order to acquire knowledge are specific. They focus on solving problems and thanks to that their members learn. Community members exchange knowledge possessed by them and this exchange stimulates their mutual development. Participation in such a virtual community as well as participation in real communities satisfy the need for a sense of belonging [23]. Jane Hart points that currently there can be identified dozens of sites, services and communication media that may be used to achieve social e-learning [14]. Many of these solutions are universal and originally were not created with the aim of education. The author mentions here, inter alia, social networking, file sharing platforms or blogs. Apart from those, there are also platforms specifically dedicated to social e-learning. As examples can be called: Elgg16, SocialText17 and Mzinga18 [29].

To the social learning theory also refers a different solution: e-portfolio. A popular software for creating electronic portfolio environment is Mahara19. E-portfolio is "digitized collection of artifacts" [18]. In other words, e-portfolio is a way to collect information about own achievements, through the creation of an electronic curriculum vitae. E-portfolio services provide a space to describe own ideas, projects and achievements. E-portfolios are important in motivating students, stimulating their development and getting them accustomed to the lifelong learning [27]. E-portfolios are already today used to monitor the professional development of university graduates.

An example of a collaborative learning are virtual worlds. Here, the participation is not limited to passive learning. The player takes up the role of an artificial character – an avatar who moves around the artificial reproduction of the real world and interacts with other

16 Elgg, (http://www.elgg.org), retrieved: 21 May 2013.

17 Socialtext, (http://www.socialtext.com), retrieved: 21 May 2013.

18 Mzinga, (http://www.mzinga.com), retrieved: 21 May 2013.

19 Mahara, (https://mahara.org/), retrieved: 3 March 2013.

players. The player becomes a part of this world and has a real impact on it. Being in the virtual world provides an opportunity to simulate the activities, processes and phenomena that can be encountered in real life. And so it is learning by doing. An example of a virtual world, which was directly created in view of education is Whyville20, dedicated to children and adolescents [12]. However, the most popular seems to be a world not made for educational purposes but adapted to them: Second Life21. Virtual worlds are, for instance, used in learning a foreign language, but also in the study of history, culture and other fields. But there are many problems of an economic, organizational and methodological nature, related to the implementation of virtual worlds for education. In other words, the results can be spectacular, but still very difficult to achieve.

5 E-learning anytime and anywhere

In addition to social networking technologies the advances in communication technology are important for the development of e-learning. Below are characterized two communication technologies adapted for e-learning.

E-learning limited only to communication in asynchronous mode (shifted in time) is an acceptable variant and at the same time cheap one. However, it is the abandonment of useful forms of communication. E-learning realized only as asynchronous does not use the full potential offered by the Internet network. The vast majority of VLE has learning objects also running in real time. Here examples include webinars, based on streaming technology, enabling convenient and rich in possibilities form of communication.

The term webinar is derived from the combination of the words "web" and "seminar". In fact, it is a web conferencing or web meeting that are enabled by tools supported by the VoIP (voice over internet protocol). Participants may be two or more, and the talk is similar to the one that is offered by the familiar Skype22. Webinars allow for: voice emission, video broadcast, slide show and presentation, file sharing, desktop sharing computers and other functionalities. Some VLEs have permanently installed software webinar. Sometimes they are an extension to the e-learning platform, as in the case of Big Blue Button23 for Moodle. Virtual seminars can be conducted also by using an external application (not associated with the e-learning platform).

The latest technology, which is treated in this paper, is mobile learning (or m-learning). The sales of notebooks and netbooks have been surpassing the desktop sales for several years. According to the Gartner report, in the second quarter of 2013, the number of smart phones sold in the world for the first time exceeded the number of mobile phones sold [13]. Mobile education market in the United States was estimated at 958.7 million dollars in 2010. Its revenues are projected to double by 2015 [1]. Mobile technologies, therefore, seem to become more and more important, thus promising for rapid development of m-learning in the near future. M-learning is dedicated to portable devices such as notebooks and netbooks, cell phones and smart phones, tablets, palmtops – PDAs, electronic notepads, as well as MP3 and MP4 players, and many more.

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20 Whyville, (http://www.whyville.net), retrieved: 21 May 2012.

21 Second Life, (http://www.secondlife.com), retrieved: 21 May 2012.

22 Skype, (http://www.skype.com), retrieved: 5 May 2012.

23 Big Blue Button, (http://www.bigbluebutton.org), retrieved: 5 May 2012.

Mobile learning is not only synchronous training, but also super-synchronous [19]. Education based on portable devices is more flexible and accessible. It is based on the use of wireless networks, focusing on even more simplified access to the content of training than it was before. All indications are that the mobile learning is a natural continuation of the e-learning development. Currently m-learning is used, among other things, to promote language learning or it is intended to assist in the return to work for the socially excluded.

It should be noted that the implementation of m-learning is typically associated with many difficulties. Extending the functionality of VLE in such a way that users can access it well on small mobile devices is sometimes a challenge. Often this involves the adaptation of ready-made solutions for mobile operating systems (iOS, Android, Windows Mobile and others) to fit screen resolutions and to navigate through the touch screen. These modifications are usually feasible, although often quite expensive from the manufacturer's point of view.

6 Conclusions

The e-learning technologies presented in the paper point to the multitude of changes occurring and the emergence of new opportunities in the field of e-learning. E-learning seems to keep up with trends in ICT. Further development may result in the loss of some of the defects that are attributed to e-learning. It should be noted, however, that the implementation of some of the proposed technologies is costly, time-consuming and not always guarantees the desired results. Building modern, efficient and tailored to the needs the virtual learning environment is always a very complex process. The use of new technologies in the virtual learning environment is risky, but on the other hand to take this risk can bring tangible benefits.

This article does not claim to be exhaustive, but merely highlights selected relevant issues in this matter in the authors' point of view. In addition to the dissemination of Web 2.0, the development of social media and mobile technologies there should also be mentioned cloud computing, teaching algorithms, repositories of knowledge, technologies for information retrieval, personalization and other issues that also affect the development of e-learning. They are the purpose of the research and scientific inquiry of the authors and the subject of subsequent publications.

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