CREATIVITY
SUPPORT SYSTEMS

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CREATIVITY SUPPORT SYSTEMS

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INTRODUCTION

In the recent years companies have been faced with a growing need to focus more of their attention on creativity and innovation in order to keep up with increased global competition. Organizational creativity and innovation are enhanced through the introduction of computer support systems. This book is dedicated to exploring issues related to supporting creativity and innovation with information technology, and contains 16 articles selected for delivery at the first international session of the CSS in the 26th Conference on Organizational Support Systems. The theme – creativity support systems (CSS) – is a rather novel one. The problem of building CSS involves the problem of building a creative organization and is located in the area of interdisciplinary research. A rich variety of methods and techniques are used to achieve this, many of which are discussed in our book.

In the first paper of this book, the authors present some selected methods that could be used for website evaluation and comparison. This research involves multi-attribute approach. In the next paper, the authors concentrate on the issue of learning objects and virtual platforms for education, and concludes that "[…] a well-configured virtual education system can be one of the most important elements of a knowledge management system". The first part of the third paper justifies tacit knowledge as a resource for organizations, while its second part focuses on the impact of tacit knowledge on various value creation models, viz. Porter's value chain, Value shop and Value network. The fourth article entitled "The Role of Knowledge Management and Learning of Companies in Innovation Processes" indicates that "[…] the respondents from research companies understand that cooperation of companies with partners and consumers generates a synergy effect during knowledge management and mutual learning in innovation processes which are executed within the framework of the network". The fifth paper proposes an "[…] ontology of creative visual design aided by computer consisting of three key concepts: a *design task*, a *visual site*, a *physical design action*, and additionally a *data structure* – helpful to support the design process by computer. Each design task is expressed in terms of requirements which are modified during the design process". The sixth paper "[…] presents an application for dictionary data integration. The application is based on a modification of ER models. A next step of work is data

integration by ontological methods". The seventh paper describes cases of deploying computer-aided support for creativity in highschools; some of these award-winning tools ran in national competitions. The eight paper discusses Data Mining methods, models and techniques that are available to business enterprises to be able to better compete in the global market and offer better products and services. The efficiency and benefits of selected Data Mining applications are illustrated by international case studies from the financial sector and the telecommunications industry. The aim of the ninth paper is to present modern IT solutions used in the process of communication between a customer and a company. It demonstrates that nowadays a company has to look for a computer system which not only could support communication with a customer through any channel, but would also take care of all processes taking place inside a company including those processes that initiate the client--company interaction. The tenth paper puts forth a proposition stating that, rather than following the opinions of others and mimicking their behaviours, the development of a culture of evidence-based actions in business organizations is advisable, or even necessary. The eleventh paper discusses the architecture of the system developed by the Institute of Economics, Rzeszów, Poland to collect data from real estate portals; a treatment of sample benchmarks and future applications in social sciences is provided, too. The twelfth paper introduces the knowledge dimension of creative business processes and uses it to show that the existing Business Process Management (BPM) systems are not suitable to support these type of processes. The paper argues that, in the case of creative business processes, the classical criteria such as cost, time and efficiency cannot been used successfully, and that such criteria as quality and creativity come to center stage instead. The thirteenth paper is focused on the application of creative decision support systems (DSS) in project management. The paper outlines the general rules for mind mapping as well as two specific methodologies: one contributed by the authors themselves, and one that has become an industry standard. The aim of fourteenth paper is to present the design framework for an autonomous personal development consultant for managers. The subsequent sections cover issues involved in automating the in--company teaching process, defining a development framework for the virtual assistant and delineating the expected outcomes of its implementation. The fifteenth article highlights the paradigm change in university education and the emergence of electronic education. Special attention is given to the concept underlying the computer system that supports teaching, research and administration at the University of Economics in Samara. The sixteenth article presents

the basic characteristics of the Invisible Web, the main reasons for its invisibility as well as the main categories of the Deep Web. The generic typology of Web sites helps categorize the phenomenon of invisible sites and pages. The article closes with rationale for using the Deep Web and its main managerial applications".

We would like to thank the authors for contributing their valuable research as well as for the time devoted in extending their original papers in the revision and editorial process. We also thank the reviewers for their helpful comments and the publishing staff who helped us prepare this book.

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CHOSEN METHODS AND TECHNIQES FOR WEBSITES EVALUATION

Introduction

Websites influence the organizations' image. They fulfill the information role mainly, but they also support communication between the enterprise and its environment (like transaction services, education websites etc.). The way the users evaluate such websites is very important, since it influences the potential demand for the goods and services offered by the website owner. The theory of business negotiation says that the first-impression effect and behavioral aspects related to the counterpart perception influence not only the negotiation process but also the final agreement and the business contract itself (and consequently the potential income of the enterprise) [LSMi99]. It is important then to design the website architecture that would be interesting (architecturally and visually), user friendly and positively perceived by its users.

While evaluating the quality of our website it is good to compare it with the websites of our major competitors. We can find our position in the ranking and identify the features of the website that should be improved. Therefore we should know how to do such a comparison, being aware that the final users may compare them in a very similar way. Building such a ranking may also have a promotional character, showing the potential clients how good our web-site is when compared with the competitors.

In this paper the authors present some selected methods that could be used for websites evaluation and comparison. Since such an evaluation involves the analysis of multitude attributes we focused on a few multiple attribute decision making (MCDM) models of various fundamentals. The major goal of this work is to summarize and synthesize the approaches for multi-criteria evaluation of the websites, that could help their owners, designers and maintainers with the identification of the quality of their systems. The authors also try to point out the advantages and disadvantages of the different methods.

1. Websites evaluation criteria

To evaluate the website we may use the same attributes as for the software systems evaluation, i.e., functionality, reliability, utility, efficiency, customizability or transferability [OlSr01, p. 22; Ziem05, p. 33]. Functionality describes how well the system manages the information and supports the enterprise activity. Reliability stands for the capability of a system for working under specified circumstances and within the defined time. Utility corresponds with the system usefulness for different groups of users and its ease of use (various aspects of website may be evaluated here, such as the system originality, help system etc.). Efficiency means a scale of the resources consumption. Customizability stands for the possibility of applying the system for the enterprise internal requirements. Transferability means the system independency of the hardware and software specification or the network type. For each of the attributes mentioned above the additional sub-characteristics may be defined, which allow to describe the system or website more precisely.

Other authors make similar classification of the evaluation criteria. In the work [Chmi10, p. 247], the author specifies the key criteria such as: technical, organizational, user-oriented (communications aspects) and policy oriented (promotional and sales aspects). Alternatively he defines [Chmi03, p. 126] such website's functionalities as: utility, innovativeness, promotional and sales aspects, that are crucial from the economic point of view for each e-business. For e-shops other specific criteria may be distinguished [Chmi09, p. 55]: functionality (website layout, payments, communication with the user), accessibility (positioning, sponsored links), visualization (graphics, colors, data visualization), security (i.e., the user's personal data safety). Another typology of the evaluation criteria is proposed in the work [Ziem05, p. 37-39]. The author suggests to focus on: the structure of websites, the quality of information, way of browsing, general impression and global characteristics (e.g., an access to the help system, language versions, disabled facilities etc.). Similar criteria are taken into consideration in websites evaluation made by the professional firms from the e-promotion market. They usually analyze: utility, content, technical aspects, graphics, position in web browsers and competitiveness [WWW1].

The evaluation criteria may be various then. The major problem is that these criteria are taken into consideration simultaneously, which make the analysis ambiguous. The compared websites in the vast majority of situations have different performance for each of the evaluation criterion and the vectors of numbers that reflect these performance cannot be easily ordered from the best to the worst one. Usually no domination in the Pareto sense occurs and other methods, technically more sophisticated, need to be applied to find the final ranking of the websites.

2. Website evaluation process

2.1. Organizing the website evaluation

The website evaluation may be conducted in several ways. According to the observation model the evaluation is done without the final users of the website but basing on the project team or the experts assessments of the system. One of the versions of the observation model is the heuristic method in which only the experts evaluate the website and its utility and functionality aspects. The evaluation basis on the predefined and commonly accepted rules (best practices) of the website designing and on the analysis of the possible ways of using the website by its final users. It aims to simulate the typical usage of the system, that could be done by a "standard user". Heuristic evaluation can help to detect problems with the use of websites. In contrast to the classic full tests it allows to obtain a valuable feedback in a short time and for relatively low costs. It gives the best effects when applied for [Kaus09]:

- optimizing the workflow,
- supporting the design of the user interface,
- understanding the general utility level of the website.

Unfortunately, when applying the heuristic method the researchers cannot be sure of the correctness of the answers. It is because the experts are not the final users of the systems and they may be misled by the group-thinking effect.

Another method used in website evaluation is a laboratory method. It requires the conduct of series of tests performed by the representative group of the website final users (e.g., tests with the web surfers) or using the benchmarking approach. The tests may be done in a laboratory or directly in the user's typical environment. These tests help to optimize the user interface and the key functionalities of the whole system. The methods that requires final users for testing the websites are also named the empirical methods. They give the great opportunity to analyze the true behavior and reactions of the final system's user, showing simultaneously the typical use cases and allowing to improve these element in the best possible way.

To measure the specified characteristics of the websites the traditional questionnaires may also be used (e.g., the use and usefulness questionnaires, pre-use and post-use questionnaires etc.). However, such questionnaires provide the researchers with the subjective data only. What is more, the users may sometimes purposely mislead the researchers by giving untrue answers, that corresponds not with evaluated website directly, but with their vision (more positive or negative) of this website. The novel techniques and methods are developed to eliminate such disadvantages, like the eye-tracking, which derives

the true behavior and the sequence of functionalities the users focus on by analyzing the path their eyes "draw" in the website layout. The results of the eye--tracking analysis allowed the Nielsen Norman Group to elaborate the best practices in building and using the websites [Kaus09, p. 92-93].

2.2. MCDM methodologies for building the websites ranking

No matter which of the organizing techniques described above is selected, finally the evaluation requires the multi-attribute comparison of the websites themselves. The list of supportive tools for such an evaluation is long and consists of the methods like classic MAUT models [KeRa76], ELECTRE [Roy96], PROMETHEE [BVMa86, p. 228-238], AHP [Saat80], TOPSIS [HwYo81] or hybrid interactive methods [Nowa06, p. 1413-1430]. Most of these tools are described in detail in the summarizing work by Figueira [Figu04]. In this work we point to only four selected analytic methods that base on different assumptions and apply different algorithms. It will allow us to analyze the impact of these algorithms on the final ranking of alternatives.

Additive scoring model (ASM)

AMS [KeRa76] allows to score the alternatives that are described in a discrete way in terms of the predefined criteria. It is the most popular MCDM method, claimed to be easy to use. However it is based on many tiresome scores assignments that require basic mathematical skills and an elementary knowledge on the theory of decision making. Its disadvantage is that the scores are simply assigned instead of being determined [FoSe01].

The main idea of AMS is to score each option according to decision maker's (DM) subjective preferences by using an artificial criterion like utility. The process of scoring offers requires:

1. *Assigning the weights* w_i for each criterion $i = 1,...,|I|$, such as:

$$\sum_i w_i = P \,, \tag{1}$$

   where P is the total pool of scoring points (usually a pool of 100 points is used).
2. *Assigning scores to each option within each criterion.* DM assigns the scoring points to each option (x_{jk}) describing the performance of alternative *j* for the criterion *k* up to the limit defined by the weight of this criterion:

$$u(x_{jk}) \in [0, w_k] \,. \tag{2}$$

3. *Determining the global scores of alternatives.* The score of alternative a_m is a sum of the comprising options:

$$u(a_j) = \sum_k u(x_{jk}). \tag{3}$$

4. *Building the ranking of offers according to descending global scores* $u(a_m)$.

An example of scoring websites with ASM is shown in Table 1.

Table 1

Evaluation of jewelry e-shops

Criterion	amelly.pl (a_1)	wkruk.pl (a_2)	silverado.pl (a_3)
Website structure (k1)			
First impression	3	5	3
Graphics	5	4	2
Website speed	4	3	5
Menu	5	4	4
Payment facilities (k2)			
Signing in	5	3	4
Payment methods	3	2	2
Technical aspects (k3)			
Links and titles	3	3	4
Multi-platform	4	4	4
Domain	5	5	5
Safty	2	1	1
Marketing aspects (k4)			
Browsers	3	4	1
Adverts	1	4	2
Informativeness (k5)			
Newsletters	5	5	5
Products description	2	2	5
Assortment	4	5	4
Facilities for buyers (k6)			
Prices	4	4	4
Packing products as gifts	0	5	2
Contact with sellers, k7			
Contact	4	5	5
Reliability	3	5	5

Source: [WWW2].

TOPSIS

TOPSIS [HwYo81] is based on measuring distances to the positive ideal and negative ideal solutions. The method uses the same additive aggregation and assumes the utility compensation similarly to the ASM. However, the TOPSIS algorithm is simpler than ASM and requires from DM assigning the criteria weights only. On the other hand, TOPSIS does not measure DM's preferences precisely, the utility scores of the criteria options are replaced with statistical distance measure, but it makes this method more "objective" than the AMS. TOPSIS algorithm requires:

1. *Building the normalized decision matrix.* Normalized vectors of x_{jk} build the normalized decision matrix *N*.
2. *Computing the weighted normalized decision matrix*. The elements of *N* are multiplied by the criteria weights w_k. A weighted normalized performances (v_{jk}) are determined.
3. *Determining the positive ideal* (*A*+) *and negative ideal* (*A*–) *solutions:*

$$A^+ = (v_1^+, v_2^+, \ldots, v_n^+), \text{ where } v_k^+ = \max_j(v_{jk}), \tag{4}$$

$$A^- = (v_1^-, v_2^-, \ldots, v_n^-), \text{ where } v_k^- = \min_j(v_{jk}). \tag{5}$$

4. *Calculating the separation measures* (distances) for each alternative j from PIS (d_j^+) and NIS (d_j^-) respectively.
5. *Determining the relative closeness of each alternative to the ideal solution:*

$$S_j = \frac{d_j^-}{d_j^+ + d_j^-}, \text{ for } j = 1, 2, \ldots, m. \tag{6}$$

where $0 \le S_j \le 1$.

The closer the alternative a_j to PIS, the larger the value of S_j.

6. *Ranking the alternatives in descending order using* S_j.

PROMETHEE II

PROMETHEE II [BVMa86, p. 228-238] applies the function $f_i(a_n)$ that returns the performance of alternative a_n for criterion i. Comparing two alternatives a_m and a_n in terms of criterion i we determine the difference $\delta_i(a_m, a_n) = f_i(a_m) - f_i(a_n)$, which is compared with preference (p) and indifference (q) thresholds and used later for building the ranking of alternatives. The ranking procedure requires:

1. *Determining the differences $\delta_k(a_i, a_j)$ for each pair of alternatives from set A and for each criterion k respectively*.
2. *Determining the values of the preference functions $P_k(a_i, a_j)$ for each criterion separately.* The preference function assigns to each difference $\delta_k(a_i, a_j)$ a value from the range $[0;1]$, which reflects the negotiator's strength of preference. Six different types of the preference function are suggested [BVMa86, p. 228-238], e.g.,

$$\mathrm{P}(\delta_i) = \begin{cases} 0 & \delta \le q \\ \dfrac{\delta - q}{p - q} & q < \delta \le p \\ 1 & \delta > p \end{cases} \tag{7}$$

3. *Calculating the overall preference indexes*:

$$\Pi(a_i, a_j) = \sum_k w_k P_k(a_i, a_j), \tag{8}$$

$$\Pi(a_j, a_i) = \sum_k w_k P_k(a_j, a_i). \tag{9}$$

4. *Identifying the leaving and entering flow for each alternative*:

$$\Phi^+(a_i) = \frac{1}{m-1} \sum_{\substack{j=1 \\ i \neq j}}^{m} \Pi(a_i, a_j), \tag{10}$$

$$\Phi^-(a_i) = \frac{1}{m-1} \sum_{\substack{j=1 \\ i \neq j}}^{m} \Pi(a_j, a_i). \tag{11}$$

5. *Determination of the preference net flow for each negotiation offer according to the formula*:

$$\Phi(a_i) = \Phi^+(a_i) - \Phi^-(a_j). \tag{1}$$

6. *Building the ranking of the offers according to decreasing value of preference net flow* Φ.

PROMETHEE does not require many tiresome assignments and calculations. However the definition of the preference threshold may be unintuitive for DM. The biggest disadvantage of PROMETHEE is the ranking reversal problem, which is typical for the methods that base on the pair-wise comparisons [KePe96, p. 457-461].

AHP

AHP [Saat80] is another pair-wise comparison-based method. It decomposes the problem into atomic elements at the various levels of the problem hierarchy that are easy to evaluate by DM. The DM needs only to decide if one of the element from the pair is more preferred than another or not. It makes its decision using the 9-point verbal scale. The major advantage of AHP is that it does not require from DM assigning scores to the attributes and options directly, but the scores are derived from DM pair-wise evaluation. On the other hand, if the decision problem is big its decomposition may cause hundreds pairs, the evaluation of which would be tiresome or even impossible to DM. AHP is also sensitive, similarly to PORMETHEE, to the ranking reversal problem.

In general the AHP procedure requires comparing all m alternatives with respect to each criterion j separately and building the comparison matrices B^j such as:

$$B^j = \begin{bmatrix} w_1^j / w_1^j & w_1^j / w_2^j & \cdots & w_1^j / w_n^j \\ w_2^j / w_1^j & w_2^j / w_2^j & \cdots & w_2^j / w_n^j \\ \vdots & \vdots & \ddots & \\ w_n^j / w_1^j & w_n^j / w_2^j & & w_n^j / w_n^j \end{bmatrix} \tag{13}$$

Each element w_a^j / w_b^j describes the importance of alternative *a* compared with alternative *b* for criterion *j*, where w_a^j and w_b^j are the weight of the alternatives *a* and *b* respectively. To find the vector of weights w^j for all the alternatives we may use the following formula:

$$\begin{bmatrix} w_1^j / w_1^j & w_1^j / w_2^j & \cdots & w_1^j / w_n^j \\ w_2^j / w_1^j & w_2^j / w_2^j & \cdots & w_2^j / w_n^j \\ \vdots & \vdots & \ddots & \vdots \\ w_n^j / w_1^j & w_n^j / w_2^j & \cdots & w_n^j / w_n^j \end{bmatrix} \begin{bmatrix} w_1^j \\ w_2^j \\ \vdots \\ w_n^j \end{bmatrix} = \begin{bmatrix} nw_1^j \\ nw_2^j \\ \vdots \\ nw_n^j \end{bmatrix} \tag{14}$$

which can be simplified to:

$$B^j w^j = n w^j . \tag{15}$$

Since we know B^j we may easily solve the formula (15) to find w^j.

3. Example – using multiple criteria methods for ranking the websites

To show the application of the selected MCDM methods for websites evaluation we will use the results of the unpublished experiment conducted by [WWW2]. In this experiment three major jewelry e-shops were evaluated by students. In the evaluation of all the criteria a 5-point Likert scale was used (Table 1). To make our analysis more transparent we would aggregate the scores within all the specified sub-criteria to obtain a reduce decision matrix (Table 2).

Table 2

Aggregated decision matrix

Criterion	Weight	Alternatives		
		(a_1)	(a_2)	(a_3)
k1	20	17	16	14
k2	10	8	5	6
k3	20	17	17	15
k4	10	6	9	7
k5	15	11	7	9
k6	10	4	9	6
k7	10	7	10	10
Total sum of scoring points		**70**	**73**	**67**

Source: [WWW2].

ASM

Having the decision matrix (Table 2) we may simply aggregate the global scores according to the ASM procedure (Section 2.2). It is enough to sum up the scores for each alternative under consideration. We obtain then: $a_1 = 70; a_2 = 73; a_3 = 67$. The ranking simply shows that the users prefer $a_2 \succ a_1 \succ a_3$. No other interpretation may be done since the ranks were ordinal.

TOPSIS

For TOPSIS we need to normalize the decision matrix and assure the weights would sum up to 1. Then, using classic Minkowski formula (with $p = 1$) for measuring distances* between alternatives we obtain the following separation measures (Table 3).

Table 3

Separation measures

	Alternatives		
	(a_1)	(a_2)	(a_3)
d^+	0,042	0,046	0,041
d^-	0,049	0,045	0,051
S	0,54	0,50	0,55

Quite unexpectedly now the alternative a_3 seems to be the most preferred by the users (the highest value *S*), while a_2 is the least preferred one. What is more, we may interpret these values on the ratio scale, which makes the results more clear to DM.

PROMETHEE II

For PROMETHEE II we will use the *p* and *q* thresholds dependent of the weight of the criterion. For the criteria weights equal to 20 we assume $p = 3; q = 2$ while for the criteria with the narrower range: $p = 2; q = 1$. We use also the same normalized weights as for TOPSIS analysis. The results are surprising again (Table 4).

* We use Kaufman and Rousseeuw [KaRo90] rationale for measuring the distances within the ordinal data.

Table 4

PROMETHEE results

	Alternatives		
	(a_1)	(a_2)	(a_3)
Φ^+	**0,37**	**0,26**	**0,18**
Φ^-	**0,26**	**0,21**	**0,34**
Φ	0,11	0,05	-0,16

The ranking says that $a_1 \succ a_2 \succ a_3$.

AHP

For AHP analysis we will use the weights of criteria and the scores as the w_k^j elements in comparison matrices. Applying the AHP procedure we obtain the following single criteria rankings (Table 5) that are finally aggregated with the vector of criteria weights $w = (0{,}210;0{,}105;0{,}210;0{,}105;0{,}157;0{,}105;0{,}105)$.

Table 5

AHP single-criteria results

	k_1	k_2	k_3	k_4	k_5	k_6	k_7
Ranking vectors	0,36	0,42	0,35	0,27	0,41	0,21	0,26
	0,34	0,26	0,35	0,41	0,26	0,47	0,37
	0,30	0,32	0,31	0,32	0,33	0,32	0,37

The final ranking vector is $(0{,}336;0{,}345;0{,}319)$, which corresponds to the preferences $a_2 \succ a_1 \succ a_3$.

Summary

Different methods may be used for the evaluation and ranking of web-sites. As the authors tried to show, no matter what the evaluation method, was the final ranking of the website may depend on the outranking method selected for ordering the alternatives. It is because these methods differently interpret the criteria option values and use them for different operations. Each of them has its pros and cons. Pair-wise-based methods are very sensitive to the alternatives that comprise the decision matrix and may result in ranking reversal problem

when some alternatives are added or removed form the matrix. TOPSIS and AHP gives the ratio scale interpreted results, which ease the analysis of the scores themselves. ASM and AHP are tiresome, since usually interact intensively with the user in assigning or determining the scores, while TOPSIS and PROMETHEE make it automatically using only pre-defined key parameters. TOPSIS however seems to be most objective of them, since the only DM--dependent input parameters are the criteria weights. On the other hand, classic TOPSIS algorithm requires strong scales data and to apply the method for the ordinal scale once some modifications are required [Wach11]. What is most important for the websites designers or e-businesses owners for promotional reasons, the ranking of the websites depends not only on the virtual parameters of these websites but is also dependent on the ranking. Therefore they may experiment with the outranking methods to adequately position their own website among the competitive ones.

Literature

[BVMa86] Brans J.P., Vincke Ph., Mareschal B.: How to Select and How to Rank Projects: The PROMETHEE Method. "European Journal of Operational Research" 1986, (24).

[Chmi03] Chmielarz W.: Analiza porównawcza wybranych księgarni internetowych. In: SWO2003. Eds. H. Sroka, T. Porębska-Miąc. AE, Katowice 2003.

[Chmi10] Chmielarz W.: Metody oceny wybranych księgarni internetowych. Polskie Towarzystwo Zarządzania Produkcją, Zakopane 2010, http:// www.ptzp.org.pl

[Figu04] Multiple Criteria Decision Analysis: State of the Art Surveys. Eds. J. Figueira, S. Greco, M. Ehrgott. Springer Science+Business Media, New York 2004.

[FoSe01] Forman E., Selly M.A.: Decision by Objectives. World Scientific Publishing, Singapore 2001.

[HwYo81] Hwang C.L., Yoon K.: Multiple Attribute Decision Making: Methods and Applications. Springer-Verlag, Berlin 1981.

[KaRo90] Kaufman L., Rousseeuw P.J.: Finding Groups in Data: An Introduction in Cluster Analysis. Wiley, New York 1990.

[Kaus09] Kaushik A.: Godzina dziennie z Web Analytics. Helion, Gliwice 2009.

[KePe96] De Keyser W., Peeters P.: A Note on the Use of PROMETHEE Multicriteria Methods. "European Journal of Operational Research" 1996, 89.

[KeRa76] Keeney R.L., Raiffa H.: Decisions with Multiple Objectives. Wiley, New York 1976.

[LSMi99] Negotiation. Eds. R. Lewicki, D. Saunders, J. Minton. The McGraw-Hill Companies Inc., Boston 1999.

[Nowa06] Nowak M.: INSDECM – An Interactive Procedure for Stochastic Multicriteria Decision Problems. "European Journal of Operational Research" 2006, Vol. 175, Iss. 3.

[OlSr01] Olszak C.M., Sroka H.: Zintegrowane systemy informatyczne w zarządzaniu. AE, Katowice 2001.

[Roy96] Roy B.: Multicriteria Methodology for Decision Aiding. Kluwer Academic Publishers, Dordrecht 1996.

[Saat80] Saaty T.L.: The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation. McGraw-Hill International Book Co., New York 1980.

[Wach11] Wachowicz T.: Application of TOPSIS Methodology to the Scoring of Negotiation Issues Measured on the Ordinal Scale. In: Multiple Criteria Decision Making '10/'11. Eds. T. Trzaskalik, T. Wachowicz. The Publisher of University of Economics in Katowice (in press), 2011.

[WWW1] Company Procreate. http://www.procreate.pl/audyt.html#metodologia_audytu (2011).

[WWW2] Ocena wykonana przez studentów Uniwersytetu Ekonomicznego w Katowicach na zajęciach z przedmiotu Strategie budowy i wdrażania metod e-biznesu (2010).

[Ziem05] Ziemba E.: Metodologia budowy serwisów internetowych dla zastosowań gospodarczych. AE, Katowice 2005.

Streszczenie

W artykule przedstawiono charakterystykę oraz porównanie wybranych metod, które można zastosować do oceny serwisów internetowych. Szczególną uwagę zwrócono na metody AHP, ASM, TOPSIS i PROMETHEE. Metody te należą do kanonu najczęściej stosowanych metod wielokryterialnego podejmowania decyzji, przy tym są stosunkowo proste w implementacji i interpretacji otrzymanych wyników. Wykorzystując dane empiryczne oceny wybranych serwisów dokonanej przez studentów Uniwersytetu Ekonomicznego w Katowicach pokazano, iż zastosowanie różnych metod wielokryterialnych może, w różnych warunkach, prowadzić do całkowicie odmiennych rankingów serwisów internetowych. W metodach opierających się na porównaniach parami może zaistnieć problem odwrócenia rankingu. Metody TOPSIS i AHP pozwalają budować rankingi na podstawie ocen metrycznych, co ułatwia i wzbogaca ich interpretację. ASM i AHP są bardziej czasochłonne i wymagają interakcji z użytkownikiem. TOPISIS i PROMETHEE pozwalają na większą automatyzację procedury analizy preferencji decydentów. Metoda TOPSIS wydaje się być najbardziej obiektywna, gdyż w budowie rankingu wykorzystuje nie subiektywne funkcje preferencji, a statystyczne metryki odległości, zaś jedyną subiektywną informacją są tutaj wagi kryteriów oceny. Z drugiej jednak strony TOPSIS w analizie preferencji wymaga danych metrycznych, co może ograniczać jej stosowalność. Najnowsze prace nad tą metodologią zmierzają jednak do rozszerzenia jej stosowalności również na problemy słabo ustrukturyzowane [Wach11].

Wnioskiem głównym, płynącym z pracy, możliwym do wykorzystania przez projektantów serwisów internetowych lub analityków rynku jest fakt, iż uzyskany ranking nie musi zależeć wyłącznie od rzeczywistych parametrów porównywanych serwisów, lecz również od wykorzystanej metodologii porównania. Dobór metody właściwej ze względów promocyjnych lub marketingowych powinien być poprzedzony dokładną analizą porównawczą metod zaimplementowanych do konkretnego problemu wielokryterialnego z uwzględnieniem analizy wrażliwości parametrów (danych wejściowych) wymaganych przez analizowane metody.

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E-LEARNING PLATFORM AS A SYSTEM OF KNOWLEDGE MANAGEMENT IN HIGHER EDUCATION

Introduction

The use of distance learning methods at universities is becoming increasingly important. Despite of problems concerning lack of legislative support and system solutions, academic e-learning has been developing successfully in Polish Universities for many years. So far e-learning has become an integral part of the learning process and university virtualization. Due to extensive usage of e-learning in Poland, it is entering into a phase of maturity. Creation of variety of courses by educators based on the different templates is not enough. Universities and industry should develop a coherent strategy for managing the process of creation, distribution and evaluation of e-learning materials.

Perfect response to emerging problems is the usage of the methodology of learning objects, which is becoming increasingly popular in the environment of e-learning professionals. The main idea behind such methodology is the ability to define and create components of knowledge, and then group them into learning objects. Created learning objects can be marked with metadata, stored in external databases, or used as a resources in the content management modules of e-learning platforms. Implementing such strategy allows to share learning objects. They can be linked together to create a complete course. The methodology of learning objects gives universities great flexibility and improves the management of training content, understood not only as complete courses but also all materials, data, information included in the educational process. Learning objects can also organize distance education services or activities involving commissioning, support and development of e-learning

processes in education unit or training of organization. This directly implies that the implementation of learning objects methodology will lead to better knowledge management in higher education.

Knowledge management is the process of conversion existing knowledge, which is difficult to parameterize and classify form such as an employee experience, to the formalized form. Knowledge management systems are generally computer systems (or individual modules) with a narrow range of functionality, but with strong mechanisms that support following processes [GrHe04]:

- acquiring knowledge
- indexing knowledge
- storage of knowledge,
- and knowledge sharing.

Functions and instruments of knowledge management system include the following three areas [Wozn02]:

- management of the intellectual activity workers (trainings, professional development, workshops and conferences),
- knowledge resource management (identification of knowledge, gathering, analysis and sharing knowledge),
- information support of knowledge management (databases, software, servers, workstations and computer networks).

Knowledge management systems are usually based on Internet applications and have some special features. If we look at their requirements posed by knowledge management systems and accessible e-learning platforms, we can see many features in common. A well-configured virtual education system can be one of the most important elements of knowledge management system.

Learning objects

Preparation of course materials and trainings is one of the most important aspects, that absorbs a large part of the operation costs spend on e-learning. This process takes place despite the fact that the various academic centers implement similar courses, based mostly on the same educational standards. In the environment of e-learning professionals, learning objects has become a core concept that involves the small objects of various types, containing a small portion of the information [Hort01]. The main feature which makes it all attractive to people preparing computer or web based trainings, is the possibility of multiple reuse existing modules, depending on the needs of learners and teachers. Frequently used analogies in this field are as under:

- Lego: idea taken directly from the object-oriented programming,
- Creation of Materials: 85% of the course elements may come from the repositories, 15% must be made from scratch to ensure the uniqueness of the target product,
- Atoms/Molecules (atoms cannot be divided into smaller elements, some atoms can be joined together into larger molecules, but it is sometimes impossible).

The important questions which need to be answered are related to determining the level of detail and defining the objects metadata.

Granularity – many authors point to a different level of details of learning object. At the lowest level we have an information object (mistakenly called by some authors as knowledge object). It consists single element such as movie, picture, animation, text, etc. Such elements may be useful for creating variety of different content. The information objects are building blocks of lessons. Lessons are grouped to achieve a specific purpose known as special curriculum modules and should be devoted less than 10 hours of instruction, which can be combined into courses, which in turn forms the major curricula.

Metadata – we cannot talk about learning objects without metadata. Each learning object should be marked with objective metadata that contains: general metadata, meta-metadata, life cycle, technical property, educational features, copyrights, relationships with other objects and knowledge classifications. It is recommended to add subjective metadata as annotations (e.g. in the form similar to the reviews for books on the Amazon bookstore).

In addition, the literature is distinguished array of features that should have learning objects. Most often mentioned are [Mcgr04]:

- *Accessibility:* the components of training should be available at a single remote point and delivered to other locations,
- *Interoperability:* the components of training may be formed at one place using a specific set of tools (the platform) or at another place using a different set of tools (on another platform),
- *Adaptability:* the training can be tailored to individual needs and circumstances,
- *Reusability:* the components of training can be used in different ways and can be included in the different training,
- *Durability:* objects can be used even when the technology on which they are made has changed, without re-designing and coding,
- *Affordability:* the effectiveness of teaching has significantly increased while the time and preparation costs are reduced,
- *Assessment:* teaching effectiveness, price and usefulness can be measured,
- *Discoverability:* objects can be easily found using simple queries,

- *Interchangeability:* an object can be easily replaced by another,
- *Manageability:* objects can be in a handy way, sort, replace and substitute,
- *Reliability:* you can specify other properties when they are needed,
- *Retrievability:* facilities should be available at any place and at any point of time.

Requirements for virtual education system

University of Information Technology and Management in Rzeszów (UITM) is a private university that has implemented new technologies in the field of education, e-learning being one of them. Staff of E-learning Department prepared the basic requirements for e-learning system based on the literature review [Zieli06] and their experience in university virtualization. They were taken in the form of the list of requirements along with a brief explanation. The system should ensure:

1. *Access from one point to all training resources* – before resources for one training were scattered, there were the FTP, external drives with learning materials which were forming courses and e-Learning platform with ready-made courses and database specifying the location of the individual resources. With such huge dispersion there were many difficulties in re-arranging course content and finding its location, thus causing unnecessary waste of time.
2. *Clear view of employees in the employer's requirements* – persons responsible for preparing the substantive content of training, especially for the first time accedes to work online, have had difficulty in meeting the quality requirements set by the university e-learning center. The new system was planned to ensure access for all employees to all materials at our disposal, good practice guidelines, the ability to query online, hold virtual consultation and provide feedback at each stage of the preparation of learning materials. Those requirements were not limited only to the process of preparation and e-learning courses sharing. There were many other people working at the university who wanted to have defined tasks and indicators (that should be in a given task achieved) in one place.
3. *Ability to manage knowledge and skills of employees* – in the context of knowledge management e-learning allows to assimilate the knowledge (information) from individuals and use it in practical activities (this makes it possible to learn and implement newly gained knowledge simultaneously). Moreover, it is possible to transfer views and assessments of such information between employees. Formed in this way, knowledge of individual workers is more efficient at the operational level, and allows the perception of opportunities (or threats) in the business environment [Zuko04].

4. *Save time of employees and students through a dedicated training* – training "off the shelf" a thing of the past, the future of e-learning is to prepare a personalized training fitting in the individual needs. Currently, all members of UITM (students and teachers that have only few technical trainings regarding the usage of e-learning platform components) are getting the same training regardless of the current knowledge and preferences. This kind of approach resulted in controversy, and the users demanded individual treatment.
5. *The ability to easily find experts in the field* – contrary to appearances, this is a fairly weighty problem which many universities especially the larger faces every day. UITM did not have a central knowledge base of employees, projects in which they participated and academic interests or previous work carried out by them. All of this information is accessible but in different departments of the organization. This resulted in difficulties of matching the experts to required tasks and the selection took place on the basis of incomplete knowledge of a supervisors.
6. *The possibility of finding a module and easy to remember subject in a given area* – courses were treated as closed entities. But it turned out that many of the courses contain the same content and there was no point wasting time and money to prepare several versions of the same materials (e.g. the issue of calculating the derivative is used in the course of mathematics, statistics, mathematical economics, numerical methods, and many others). Implementation of the methodology of learning objects can break existing content into smaller portions, making it easier to find interesting topic, and will allow weak students to choose objects whose contents cannot be mastered by them sufficiently. Better students will be able to move immediately to the appropriate course content.
7. *Providing data to managers at various levels* – a single system should gather all the information and enable decision makers such as President, Dean, Head of Departments to easily extract information about individual employees, students, the implementation status of each task in a transparent and easy to interpret diagrams and reports.
8. *Circulation of information concerning the university and internal processes* – implementation of workflow model and formalizing the flow of documents within the university provides an opportunity to replace intranet and gather all the relevant information both on the internal (administrative) task of the university and the organization of teaching process onto a one place. Doing this will provide a standard procedure for solving problems in the University.

9. *Access to "living knowledge" – contact with staff and experts* – provides easy-synchronous and asynchronous communication and video transmission so that the experts and university staff were available and able to communicate using the platform tools. An important aspect is possibility of register communication between users, so that each party may at any time to have an insight into the latest findings.

The above stated facts shows that the requirements for e-learning systems are in line with the greater part of the requirements of knowledge management systems [StSr05]. Looking at the many similarities between these systems it can be concluded that the implementation of e-learning in higher education will also facilitate the transition from the present way of manages information to knowledge management way. With e-learning platform knowledge resources can be shared with certain groups of eligible individuals. Sharing information helps in the integration of employees and hence has an influence on organization knowledge.

Implementation Activities

First teaching materials at UITM in the form of e-courses were distributed among students in 2000. Until 2009 University had tested and implemented several e-learning platforms (own authoring tools, Lotus Learning Space IBM, WBT Server platform). None of the above solutions mentioned met the expected results, precisely because of the inadequate representation of the functionality in knowledge management. Currently UITM purchased a new e-learning platform – Blackboard Learn™ which in part fulfills requirements to virtual education systems described in the previous section. It should be emphasized the purchase of all four modules, the platform. The most important functions from the standpoint of our university were collected and are shown in the table below.

Table 1

Basic functionality of the Blackboard platform

Module Name	Basic functionality
1	2
Course Delivery	create content using Web 2.0 interface, the ability to prepare the individual paths of learning, students interaction: blogs, group work, mutual learning by encouraging group activities, monitor student activity

Table 1 cont.

1	2
Community Engagement	providing personalized messages and content to different groups of students, access to all users to the courses content, community information and data from the organization, integration of online services and student management system with a single platform, the creation of project groups by launching a virtual space where members can quickly share resources, create space for the development of scientific circles, clubs and associations
Content Management	storing documents and files for different courses and groups in one central repository of teaching materials, storage of courses in one place instead of duplicating the same elements in many places, the ability to configure built-in document circulation system, creating a portfolio for various groups such as students, staff and scientific – Teaching, administrative staff
Outcomes Assessment	data collection and information about the teaching process, creating reports that are easy to read and give a direct and fast answer to questions and view at achieving the goals, monitor progress of individuals within and across institutions

Source: Own study based [WWW1].

In addition, it should be emphasized that the progress of users can also integrate external and internal tools with Blackboard Building Blocks™ and other open source systems. This aspect was quite important when choosing a platform. In a team of e-learning, UITM has programmers who are able to encode needed functionality. This is especially important when there are problems in the middle of the semester and the next update of platform is planned at the end of the semester.

Moreover the Polish institutions that use this platform acquire only two basic modules, Course Delivery and Community Engagement. UITM decided to purchase the remaining two modules in order to fact that platform could serve as a key element in knowledge management system in the organization and to replace present scattered services.

Particular focus is now on how to best configure the content management module based on the methodology of learning objects. According to the proposed timetable for the academic year 2011/2012 content management module of platform will be implemented and an impact study of learning objects in knowledge management process in the areas of training needs analysis, design, provision and evaluation of courses and training materials and procedures to the new methodology will be conducted. An important problem to investigate here is whether in other areas it would be possible to use learning objects, e.g. in the description of the various organizations belonging to the university, creating portfolios etc.

Conclusions

In case of large organizations such as Universities, it is necessary to remodel the existing procedures, processes and the state of mind of employees. Advanced e-learning platforms can successfully be a key component of knowledge management systems in an organization which in future will replace the e-learning platforms.

Literature

[GrHe04] Grudzewski W., Hejduk I.: Zarządzanie wiedzą w przedsiębiorstwach. Wydawnictwo Difin, Warszawa 2004.

[Hort01] Horton W.: Designing Knowledge Object – Crafting Reusable Component for Teaching, Communicating, and Entertaining. William Horton Consulting, 2001.

[Mcgr04] McGreal R.: Online Education Using Learning Object. RoutledgeFalmer, London 2004.

[StSr05] Stanek S., Sroka S.: Wirtualna edukacja. Koncepcja i wybrane kierunki realizacji. AE, Katowice 2005.

[Wozn02] Woźniak K.: Oprogramowanie Lotus Domino jako narzędzie zarządzania wiedzą w przedsiębiorstwie. Materiały konferencji naukowej Zarządzanie firmą w społeczeństwie informacyjnym, Kraków 2002.

[WWW1] http://www.blackboard.com

[Zieli06] Zieliński Z.: Systemy informatyczne w zarządzaniu e-learning. Zeszyty Naukowe Świętokrzyskiego Centrum Edukacji na Odległość, nr 2, Kielce 2006.

[Zuko04] Żukowska-Budka J.: E-learning jako forma rozwoju zawodowego pracowników. W: Instrumenty i formy organizacyjne procesów zarządzania w społeczeństwie informacyjnym. Ed. A. Stabryła. AE, Kraków 2004.

Streszczenie

Nauczanie na odległość stało się w praktyce działania uczelni wyższych integralnym elementem procesu kształcenia. Współczesne zaawansowane platformy e-learningowe powinny nie tylko dostarczać treści kształcenia, ale stanowić główny składnik systemu zarządzania wiedzą w organizacjach. W artykule przedstawiono wymagania stawiane systemowi e-learningowemu opartemu na porządku obiektów wiedzy oraz zaproponowano działania wdrożeniowe służące przekształceniu istniejącej platformy wykorzystywanej w WSIiZ w Rzeszowie do postaci rozbudowanego systemu zarządzania wiedzą w różnych obszarach działalności uczelni.

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TACIT KNOWLEDGE AS AN INIMITABLE RESOURCE AND ITS INTENSITY IN VARIOUS KNOWLEDGE INTENSIVE VALUE CREATION MODELS

Introduction

According to the resource-based theory of an organization tacit knowledge is considered as a valuable, unique, and difficult to imitate resource and in context with activity-based theory of an organization it is considered as a driver of all activities which provides basis for organization's performance and thereby providing organization a competitive advantage over others. Tacit knowledge is an intangible and dynamic asset of any organization [Gott04, ch. 2]. Alavi and Leidner suggested that the long-term sustainable competitive advantage comes from the firm's ability to effectively apply the existing knowledge to create new knowledge and to take action that forms the basis for achieving competitive advantage from knowledge-based assets [AlLe01]. Tacit knowledge acts as an intangible resource or driver for an organization.

First part of this article justifies tacit knowledge as a resource for organizations and second part focuses on the impact of tacit knowledge in the various value creation models viz. Porter's value chain, Value shop and Value network.

Tacit knowledge in organization performance

The resource-based view of the firm has emerged as a major paradigm in the strategic management field. At the basic level, the resource-based view of an organization is based on three straightforward propositions. The three propositions are as follows:

- organizations differ on the basis of their resource endowments,
- resource heterogeneity gives rise to differential performance,
- superior performance persists as long as there are various mechanisms incorporated to protect the valuable and rare resources.

As the theory has developed and research was performed to justify knowledge as a resource it was being concluded that tacit knowledge is an organization's intangible resource. Similar arguments concerning role of tacit knowledge as resource has diminished the valuability of human capital.

Human capital is no longer been argued as a critical resource in most organizations. Recent research suggests that human capital attributes such as tacit knowledge affect organization's outcomes and leverage their true capabilities [Hitt et al., 2001]. Moreover it's the only resource having increasing returns as it is used. The more it is used, the more valuable it becomes, creating self--reinforcing cycle. To define tacit knowledge as a resource, we can correlate it with the three supplementary methods which exist to identify needs for knowledge. The three methods are problem decision analysis, critical success factors, ends means analysis [Gott04, ch. 2]. Figure 1 highlights the three methods. If we closely refine their granularity we will come to the conclusion that definitely tacit knowledge is a resource which adds value to an organization.

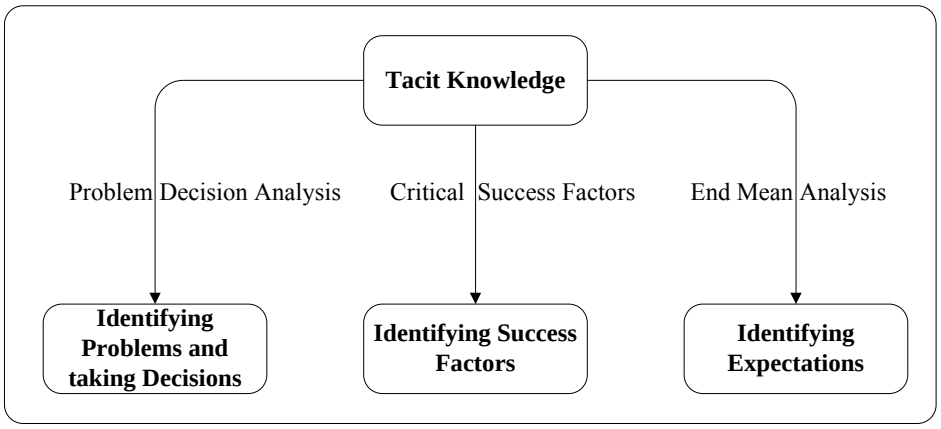

Figure 1. Tacit knowledge as a resource

Let us consider a situation depicted in Figure 2, which will demonstrate how tacit knowledge acts as a resource in correlation with above stated aspects.

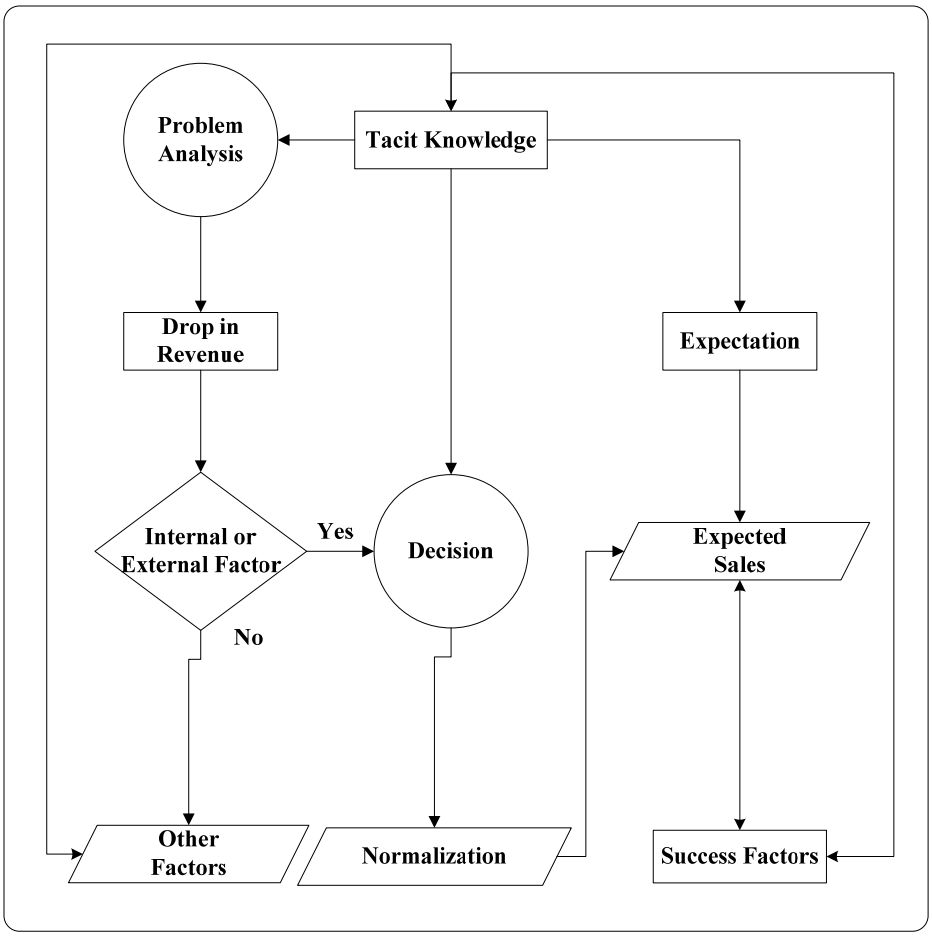

Figure 2. Analogy tacit knowledge as a resource

In this illustration I have considered a manufacturing organization which is producing a physical product. After a yearlong work on tactics and finalizing the goals and expectations the business outcome was not up to the mark. The financial statement highlighted that there is a decrease in revenue. Due to the decrease in revenue of an organization the managers will use embedded tacit knowledge and some figures to know the problem which led to such a situation. This is the problem analysis. After analysis it was found that the primarily reason for reduction in revenue was due to drop in sales. Then tacit knowledge allows decision makers to think over a possible cause which involves factors viz. internal and external factors. Internal factors involve reduction in quality or rise in sales price and external factors involve the competition producing

the same product. Depending on the type of factor involved in the drop of sales appropriate decision will be taken in accordance. After the decision is being taken the expected results will be analyzed, if positive, the solution will be incorporated in the list of success factors where tacit knowledge plays a significant role.

Tacit knowledge in value chain

As stated and elaborated above that how tacit knowledge acts as an intangible resource or driver for an organization, now I have analyzed this resource as a part of value chain.

Porter's value chain framework (1985) is presently the accepted language for both representing and analyzing the logic of organization-level value creation or performance builder. In spite of having some limitations which will be discussed in upcoming topic, it maintains its central role as a framework for the analysis of organization-level competitive strengths and performance. The value chain as described by Porter is a two-level generic taxonomy of value creation activities which in turn make organization's highly competitive by increasing their performance level. The framework is based on Thompson's (1967) long-linked topology in which value is created by transforming input into products. The two levels in Porter's value chain constitute primary and support activities of an organization. Primary activities consist of inbound logistics, operations, outbound logistics, marketing and sales, and service and support activities include procurement, technology development, human resource management and firm or organization infrastructure. If we speak about the usage or involvement of tacit knowledge in the primary activities, the high involvement can be seen in operations, marketing and sales, service and logistics have minimum involvement. In the same context the support activities all have highly embedded tacit knowledge.

Operations are associated with transformation of inputs into final products. So if we consider change in the market for any product, at that instant tacit knowledge will play a vital role in determination of any change in operations [LeGo93]. Concerning marketing, sales and service it is necessary to determine the mindset of customers and market behavior and it is always important to have an exact view of all relating status and during this analysis tacit knowledge provides the intuition and zeal. Regarding support activities all except infrastructure require high intensity of tacit knowledge for proper management. All this is well supported by the above explained effect of tacit knowledge on organization's performance

The Figure 3 demonstrates the intensity of tacit knowledge in porter's value chain model. The Tacit Knowledge Intensity (TKI) is shown by low, moderate and high levels.

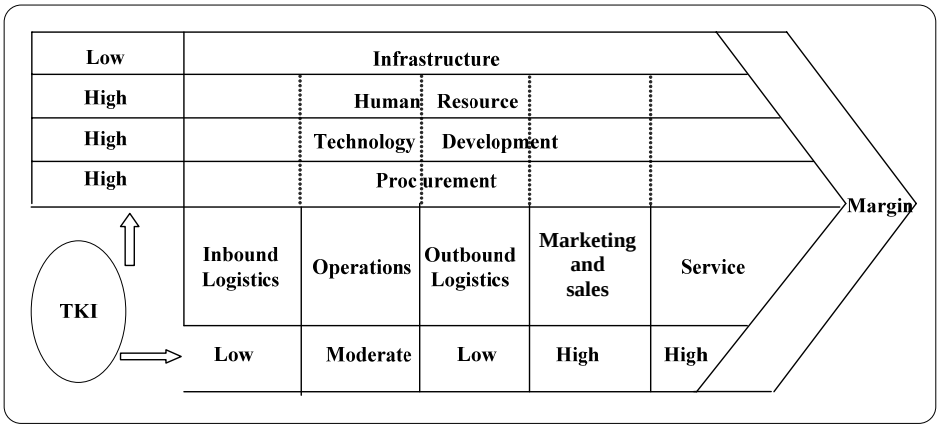

Figure 3. Tacit Knowledge Intensity (TKI) in Porter's value chain

Tacit knowledge in value shop and value network

The topology described by Porter is well suited for traditional manufacturing organizations but this logic is less suitable to activities in a number of service industries like insurance companies, hospitals, educational institutes, banks, telephone companies and organization which are in similar genre of business. For these types of organizations value shop and value network configurations are desirable [StFj98, p. 414].

Value Shop

The value shop models organizations where value is created by mobilizing resources and activities to resolve particular customer's problem. This model is based on intensive technology approach and these organizations are often called professional service firms or knowledge-intensive service firms [Gott04, ch. 2]. Knowledge is the most important resource, and reputation is critical to organization success. Instances of such organizations are medicine, law, architecture and engineering. The 'shop' label captures that an organization so configured is directed at a unique and delineated class of problems [StFj98, p. 421].

A value shop is characterized by five primary activities: problem finding and acquisition, problem-solving, choice, execution, and control and evaluation [Gott04, ch. 2]. In addition to this the support activities are similar as in value chain. As clear from the primary activities, we can say that they belong to

problem-solving and decision-making genre, thereby making tacit knowledge an important aspect of the organization. Due to this reason we can typically find scientists and experts in these types of organizations. The intensity of tacit knowledge requirement is very high in all primary activities while the support activities have same level as described in porter's value chain. The Figure 4 below shows the generic value shop diagram where post execution evaluation can be the problem-finding activity of a new problem-solving cycle [StFj98, p. 424] and it also depicts Tacit Knowledge Intensity (TKI) levels.

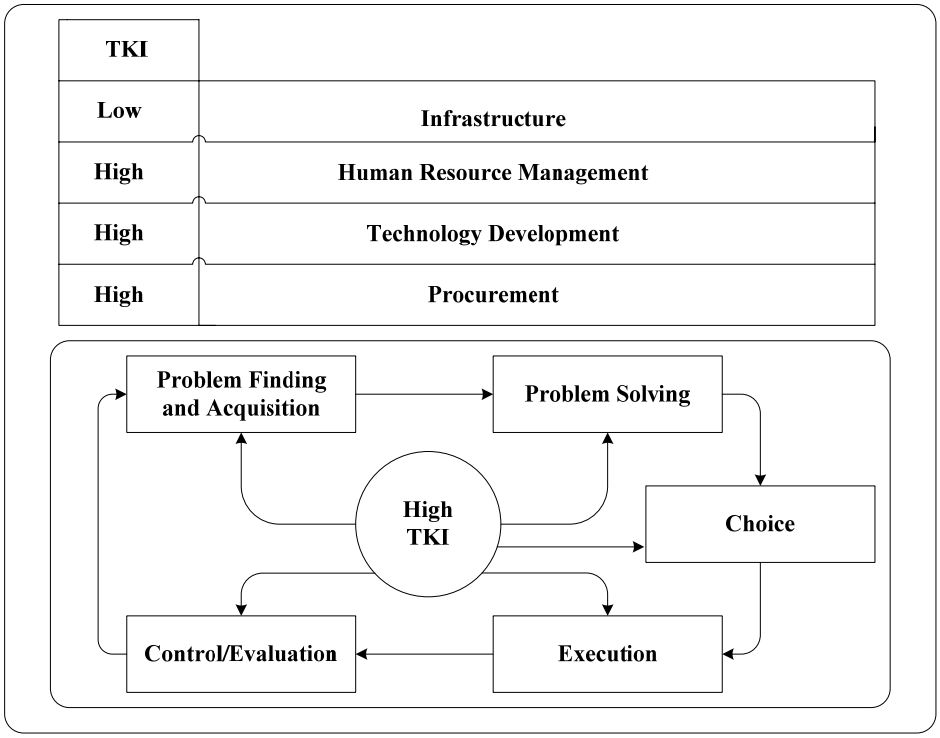

Figure 4. Tacit Knowledge Intensity (TKI) in Value shop

Value Network

A value network is an organization that creates value by connecting clients and customers that are, or want to be, dependent on each other. These companies distribute information, money, products and services. While activities in both value chains and value shops are done sequentially, activities in value networks occur in parallel. The number and combination of customers and access points in the network are important value drivers in the value net-

work. More customers and more connections create higher value to customers [Gott04, ch. 2]. So a value network relies on mediating technology. Examples of organizations using mediating technology are telephone companies, retail banks, postal services and so on. The primary activity description in these organizations is inspired by that used in telecommunication because telecommunication is a rather generic form of mediation and because explicit activity decomposition models are well established both at the micro level of peer-to-peer communication and at the industry level in delineating industry actors [StFj98, p. 429]. The primary activities of value network are network promotion and contract management, service provisioning and network infrastructure operation and the support activities are the same as in porter's value chain and value shop. Talking about tacit knowledge intensity in value network, it is not as intensive as it is in value shop. Among all three activities, network promotion and contract management has a high intensity of tacit knowledge in it as it involves selling services, evaluating risk and monitoring contracts. As in my view as the activities in value network act in parallel so we can say that service provisioning as a direct effect on network promotion so has the same tacit knowledge intensity enveloping it. Regarding infrastructure operation the intensity is fairly less as these operations have proper procedures to follow. The Figure 5 depicts a value network (Stabell and Fjeldstad) and Tacit Knowledge Intensity (TKI) in it.

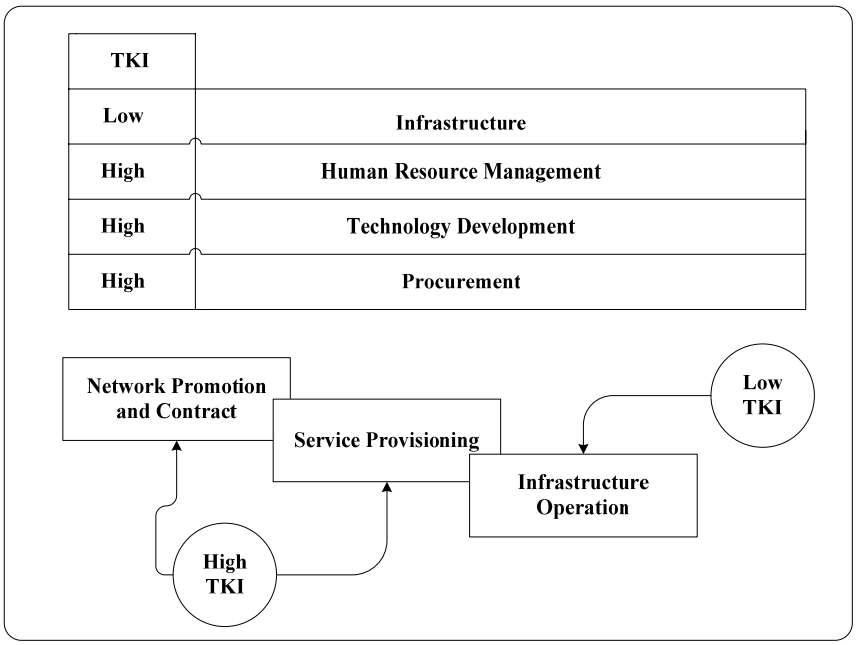

Figure 5. Tacit Knowledge Intensity (TKI) in Value Network

Comparison between value configurations

Value chain, value shop and value network are alternative value configurations that determine the intensity of tacit knowledge in an organization. Table below shows comparison between value configurations (Stabell and Fjeldstad) with an overall Tacit Knowledge Intensity (TKI).

Table 1

Comparison between Value Configurations

Characteristics	Value chain	Value shop	Value network
Value Creation Logic	Transformation of Inputs into Products	(Re)solving Customer or clients Problems	Linking Customers
Primary Technology	Long-Linked	Intensive	Mediating
Primary Activities Categories	Inbound Logistics Operations Outbound Logistics Marketing and Sales Service	Problem-finding and Acquisition Problem-solving Choice Execution Control/Evaluation	Network Promotion and Contract Management Service Provisioning Infrastructure Operation
Main Interactivity relationship Logic	Sequential	Cyclical, Spiraling	Simultaneously, parallel
Business Value System Structure	Interlinked Chains	Referred shops	Layered and interconnected Networks
Overall TKI	**Moderate**	**High**	**Moderate**
Examples	Car Manufacturer	Law Firm	Telephone Company

Literature

[AlLe01] Alavi M., Leidner D.: Knowledge Management and Knowledge Management Systems: Conceptual Foundation and Research Issues. "MIS Quarterly" 2001, Vol. 25, No. 1, March.

[Gott04] Gottschalk P.: Strategic Knowledge Management Technology. Idea Group Publishing, UK 2004.

[HaVo07] Harrington J., Voehl F.: Knowledge Management Excellence. Paton Press LLC, USA 2007.

[LeGo93] Ledeboer W.A., Gorter T.R.: ESPRIT: Successful Industrial R & D Cooperation in Europe. "International Journal of Technology Management" 1993, Vol. 8, No. 6/7/8.

[Murr08] Murray E.J.: Current Issues in Knowledge Management. Information Science Reference, USA 2008.

[StFj98] Stabell C.B., Fjeldstad D.: Configuring Value for Competitive Advantage: On Chains, Shops, and Networks. "Strategic Management Journal" 1998, Vol. 19.

Streszczenie

Wiedza ukryta okazuje się wciąż wyzwaniem w każdej dziedzinie przemysłu i bez wątpienia jest wiecznym źródłem wiedzy. Dlatego ważne jest, aby uświadomić sobie intensywność i wpływ wiedzy ukrytej w organizacjach na różnych etapach ich działania. Takie postępowanie pomoże osiągnąć koncepcyjną uwagę dotyczącą koncentracji technik wychwytywania wiedzy ukrytej, technologii oraz metodologii na określonych etapach biznesu. Głównym celem tego artykułu jest analiza wiedzy ukrytej jako niepowtarzalnego zasobu oraz podkreślenie ważności czynnika Intensywności Wiedzy Ukrytej w każdym rodzaju organizacji, które z upływem czasu coraz bardziej wykorzystują intensywność wiedzy.

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THE ROLE OF KNOWLEDGE MANAGEMENT AND LEARNING OF COMPANIES IN INNOVATION PROCESSES

Introduction

At present, economic prosperity depends on the development of knowledge and its efficient application in innovations [John05]. Innovations are knowledge products resultant from the execution of innovation processes. These processes comprise knowledge management activities. Innovation processes entail knowledge sharing and development, learning of associated companies which cooperate with one another in the network in exploiting their resources. With learning and development of companies in the innovation network, knowledge and other resources are multiplied.

Innovation arises from complex interactions and relationships between individuals, firms-partners of the network and their operating environment during the implementation of innovation processes. The knowledge and learning capacities of people and companies are instrumental for innovation processes and the innovation capacity development of innovative network and its partners. They cooperate among themselves and learn mutually during the execution of innovation process activities and then they use, transfer and develop their knowledge resources [Dilk08].

The objective of this work is to explore the current state of knowledge management and learning of companies during innovation processes execution in the network. Questionnaire research on this subject was conducted by author in Lubelskie region in 2009. Summary results of these research are described in this work.

Knowledge management of companies in innovation process

The innovation process consists of the following activities: development of a new solution concept, innovation elaboration, its application, promotion and selling on the innovation market, and also its improvement at all times. It is a process of knowledge management and mutual learning of the network organization partners. During the course of the process interactions and relations are shaped among its contractors connected with the flow, application, and development of shared knowledge and information. The results of companies collaboration in the network during mutual knowledge management and learning in innovation processes are synergic effects [Doli10]. During the course of innovation process relations are shaped among its contractors connected with their learning and the flow, application, and development of shared knowledge. This, in turn, becomes a source of new innovative solutions.

The role of knowledge transfer and development is central to the innovation process. Knowledge management has been loosely applied to a collection of organizational practices related to generating, capturing, storing, disseminating and applying knowledge.

In many ways, knowledge management can be viewed as an innovation that is rapidly diffusing among organizations. The pursuit of knowledge management is often based on the premise that it will lead to better and more expedient decision-making and it will give rise to more creative handling of organizational problems. Thus, the ultimate outcome of effective knowledge management is the rapid adoption or creation of appropriate innovations that can be successfully implemented within the context of a particular organization. Greater knowledge intensity leads to greater profitability for commercial companies and to higher levels of innovation. Ultimately, knowledge becomes the source of wealth and economic growth [John05].

Currently, the knowledge-based view of an organization considers knowledge as the most strategically significant resource of an organization. This view highlights the importance of a set of knowledge processes that range from innovation and the creation of new knowledge through to the opportunities for leveraging existing knowledge through the adoption and adaptation of promising practices [NaGR05].

Knowledge management in companies focuses on the following areas [Wiig95]:

1. Survey, develop, maintain, and secure the intellectual and knowledge resources of the organization.
2. Promote knowledge creation and innovation by everyone.

3. Determine the knowledge required to perform work tasks, make the requisite knowledge available, and distribute it to the relevant points-of--action.
4. Modify and restructure the organization to use knowledge in innovation process activities most efficiently, maximize the value-added knowledge content in innovations.
5. Create, govern, and monitor future and long-term knowledge-based activities of innovation processes; particularly new knowledge investments (R&D) and collaboration among partners of the network during knowledge development.

Innovation, the effect of the development of knowledge, now determine the economic success of the organisation in a knowledge-based economy. The value of the organisation in a knowledge-based economy depends on its ever--growing resources of knowledge, including learning and competencies of its people, and its effective application in its activity and in the business offer addressed to its clients/customers.

Every country should construct open innovation systems, and that not only focuses on the participated public and private sectors but also expands to relative economic structure, and various social cooperation networks that help effectively improve collective learning and knowledge management in innovation processes [Chen08].

Structural changes in a knowledge economy mean that managers will increasingly seek to make cooperative relationships the norm in their organisations. Research and experience have shown that a knowledge economy is also a relational economy since the structure and quality of relationships which are shaped in networks are a major influence on both the creation and exploitation of knowledge [NaGR05] in innovations. Network flexibility allows the company and its partners to learn and react quickly to unexpected situations, and to develop innovations effectively.

Learning of innovative companies in the network

Innovative companies focuses on the following areas:

1. Knowledge creation, transfer, development and application in innovations.
2. Taking part in accomplishment of innovation process activities.
3. Application of innovation in its inside and outside activities.
4. Cooperation and learning with partners/clients during innovation process execution.
5. Knowledge transferring from experts and specialists outside the company.
6. Development own R&D entity (laboratory) and/or cooperate with R&D entities. universities, science parks, clusters from outside.
7. Promotion and sale of innovations.

Knowledge transfer, development and using in innovation processes are keys to innovative company success on the market. To survive in the long time period, companies must be able to learn efficiently, develop knowledge and use it in innovations. They must anticipate changes and put innovation into practice or sell them on the market.

Innovations have come to be based on the interactions, knowledge, and information flow between economic entities such as companies (partners, suppliers, competitors and their consumers), research organizations (universities, other public and private research and development institutions), public agencies (innovation transfer centers, development agencies, industry or science and technology parks), finance institutions (innovation financial support: venture capital, funds, and loans) and regional or local authorities. These entities may collaborate and learn among themselves as partners of the network during the execution of innovation process activities [Doli10].

In this paper, networks are understood as a mode of organization which legally independent companies voluntarily chose over hierarchical or market modes of organization by establishing flexible ties and sharing collective assets among each other, in order to sustain or strengthen their competitive position. Based on this definition, innovation networks can be understood as a mode of organization in which two or more independent firms aim at jointly researching, developing or dispersing innovations [Dilk08].

Rogers exposes network analysis as one of the main streams of investigation in contemporary research on diffusion of innovation. Seeing an organization as a network has important consequences for knowledge management. A knowledge managers should be aware of this network and should try to use it in order to help distribute knowledge throughout the organization [Roge03].

Dimovski and Škerlavaj provided empirical support for the notion that higher-level organizational learning contributes to increased value added per employee, return on assets, employee and customer satisfaction, and the quality of relationships with main suppliers [PaŠD08] and partners in the network.

De Geus, one of the early researchers in the field of organizational learning, stated that ability to learn faster that your competitors may be the only sustainable competitive advantage [DeGe88].

The one view on organizational learning comprise an understanding of learning as the individual acquisition of knowledge and skills. On the other hand, the participation perspective is derived from practice-based studies in which no teaching was observed. Within this perspective, learning is understood as participation in communities of practice; as a movement from a newcomer to being out of the individual mind and formal education settings and places it in everyday organizational life and work [PaŠD08].

In fields where scientific or technological progress is developing rapidly, and the sources of knowledge are widely distributed, no single firm has all

the necessary skills to stay on top of all areas of progress and bring significant innovations to market. In such settings, networks can become the locus of innovation, as learning and the creation of knowledge are crucial to improving competitive position [Lazo06].

Knowledge is acquired, created and retained in innovation process activities, and it is the most important resource used during the learning processes which are place in the company and connected with its environment. Enterprises must partner effectively with other institutions, companies in the innovation area to learn themselves and to form a competitively superior value-delivery network on the innovation market [Doli10]. Co-operative partnership adapt the learning processes to all partners of the network and build on the base of them competitive advantage.

The network competence consists of the ability – or knowledge – to consolidate bundles of interpersonal technologies and skills. These are concerned with the mechanisms that integrate various intellectual entrepreneurial and organizational skills and technologies. The mode of knowledge management here is not person-centered but innovation process-centered. Relationships of companies with partners/consumers in the network are based on development and transfer knowledge and collective learning, which results are used in innovation processes.

Questionnaire research on knowledge management and learning of companies during innovation process activities execution

The study on knowledge management and learning of companies during innovation process activities execution was conducted on respondents from 64 innovative companies of the Lubelskie Voivodeship in 2009. We considered innovative companies to be the most suitable population on which to carry out the empirical study. The research sample was chosen as nonprobability, judgment sample of companies. The selection of the representative sample was based on the criterion of their activity, i.e. 50% of industrial processing companies and 50% of this number was made up by service providers. The breakdown of the analysed companies structure by size was as follows: 25% were micro-, 34,4% – small, 28,1% – medium companies, and 12,5% were large corporations.

92,2% of companies were sold their products on regional market, 78,1% of them – on Polish market, and 45,3% – on foreign market. Among the analysed companies were manufacturers of well known brands not only on the region and Polish market but also on the foreign markets (mainly in the European Union). The analysed companies cooperate with partners in distribution channels and learn from them in Lubelskie region, in Poland and also countries

abroad.

Employees of the firms continuously improve their competencies and apply their knowledge in their innovative activities and offer addressed to clients. University graduates constituted the biggest part of the staff in the companies under analysis, and their number was bound to rise in the years to come. Employees in 98,4% of companies combined their work with graduate studies, M.Sc. studies, courses in engineering and undergraduate studies. Employees of firms constantly developed their competences and results of the research showed that following dependence – the bigger the firm, the smaller the number of employees with higher education. Company staff continued to develop their professional qualifications by attending various training courses. On average, each employee attends 10 hours of training per year.

Employees from 48,4% of the companies took part in conferences, scientific seminars last year and then they built relationships with personnel of universities, research or scientific institutes. These relationships were based in learning and knowledge exchange, and application of it in innovative solutions.

The most (73,4%) firms put into practice product innovations during the last three years, in turn 65,6% firms applied innovative technology, 59,4% firms – innovations in management, and 46,7% firms – new business processes. In quantitative terms, innovative solutions on a regional scale were dominant (made up 68,1% of all innovations), followed by innovative solutions on a national scale (23,4%). During the analysed period the companies in question implemented as few as 8,5% of innovative solutions on an international scale. Such data indicate that companies increased their activities to ensure a more competitive nature of their innovations on the national and international arena. This new stance could be attributed to Poland's membership in the European Union.

The majority of innovative solutions implemented in companies resulted from in-house development projects. This clearly indicates that there was considerable potential in partnership cooperation and learning in the area of innovation which has not as yet been utilised.

Performance of firms in the network should depend on the knowledge assets stock and their skill in organizing knowledge creation, exchange and using in innovation processes. Innovative assets are a result of internal and external learning, and also sources of knowledge.

The analyzed companies cooperate, mutual learn and exchange knowledge with partners at home and abroad. The research results showed that the majority (95,3%) of companies cooperated, exchange knowledge and learnt with partners at home, and fewer (43,8%) firms – both home and abroad, and only 4,6% – abroad. The capacity for assimilation of external knowledge depends on the company's internal capacity and how it structures its relations with the environment. Most (62,5%) firms cooperated during innovation process execution with firms in the same line of business at home, however 34,4% –

with firms abroad. Fewer (46,9%) firms cooperated with firms different line of business at home and 15,6% – abroad, and only 20,3% firms cooperated with home universities, and fewer (17,2%) – with R&D entities at home, and very few (1,6%) – abroad.

Respondents determined possibilities of knowledge and information system on innovation in their firms. Development of knowledge for innovation purposes was carried out by the majority (76,6%) of companies on their own and 28,1% of the companies carried out the same in association with their partners. The majority of the companies focused their activity primarily on acquisition of knowledge and information required for innovation creation and application from the outside, but fever companies (28,1%) developed knowledge for innovation creation with their partners.

56,3% of the companies carried out R&D activity, and 37,5% – carried out it on their own, 28,1% – only collaborated with other entities in this field, and 10,9% – carried out this activity on their own and also with specialist firms outside. The companies carried out their R&D activity largely on their own.

The majority (76,6%) of the companies conducted market analyses, marketing research to accumulate knowledge on innovations. However, fewer (25%) companies had the capacity and knowledge to market new products in an effective manner and 40,6% of firms collaborated and learned with partners in innovation processes effectively. For 56,3% of companies the base of relationships shaping with partners, clients were the collaboration and mutual learning with them during knowledge management in innovation processes. The majority (93,8%) of firms were provided by the internet with knowledge, information, and 56,7% – conducted online market analysis and research on innovations.

The priorities of the innovation activity indicated by the companies include entering new foreign markets (in 65,5% of firms) followed by partnership cooperation and learning in knowledge management area in innovation processes (in 51,6% of firms).

Conclusions

Knowledge is the most valuable resource of any company. The future success of the company lies on the ability to learn and to create knowledge, and to use it efficiently in innovations.

The respondents were well aware of the effects of knowledge management and innovation on the strengthening of their competitive market positions. The results of the study indicated that entrepreneurs were interested in boosting participation of their companies in innovation processes with a view to increasing their cooperation and mutual learning with partner firms and clients in the network area.

The results of the research illustrate the growing links between firms and their partners in the innovation activity area. The respondents from research companies understand that cooperation of companies with partners and consumers generates a synergy effect during knowledge management and mutual learning in innovation processes which are executed within the framework of the network.

Literature

[Chen08] Chen Ch.: Causal Modeling of Knowledge-based Economy. "Management Decision" 2008, Vol. 46, No. 3.

[DeGe88] De Geus A.P.: Planning as Learning. "Harvard Business Review" 1988.

[Dilk08] Dilk Ch., Gleich R., Wald A., Motwani J.: State and Development of Innovation Networks. "Management Decision" 2008, Vol. 46, No. 5.

[Doli10] Dolińska M.: Innowacje w gospodarce opartej na wiedzy. Polskie Wydawnictwo Ekonomiczne, Warszawa 2010.

[John05] Johnson J.D.: Innovation and Knowledge Management. Edward Elgar Cheltenham, UK, Northampton, MA, USA 2005.

[Lazo06] Lazonick W.: The Innovative firm. In: The Oxford Handbook of Innovation. Eds. J. Fagerberg, D.C. Mowery, R.R. Nelson. Oxford University Press, Oxford 2006.

[NaGr05] Nahapiet J., Gratton L., Rocha H.: Knowledge and Relationships: When Cooperation Is the Norm. "European Management Review" 2005, No. 2.

[PaŠD08] Pahor M., Škerlavaj M., Dimovski V.: Evidence for the Network Perspective on Organizational Learning. "Journal of the American Society for Information Science and Technology" 2008, 59(12).

[Roge03] Rogers E.M.: Diffusion of Innovations. Free Press, New York 2003.

[Wiig95] Wiig K.M.: Knowledge Management. The Central Management Focus for Intelligent-Acting Organizations. Schema Press, Arlington, Texas 1995.

Streszczenie

Celem niniejszego opracowania jest zbadanie aktualnego stanu zarządzania wiedzą i uczenia się firmy podczas realizacji procesów innowacji w sieci. Badania ankietowe na ten temat przeprowadzono w województwie lubelskim w 2009 roku. Artykuł opisuje zbiorcze wyniki tych badań.

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COMPUTER AIDED CREATIVITY FOR VISUAL DESIGN

Introduction

Sometimes, the first part of design process consisting in an understanding of the requirements goes together with the visualization of early design solutions [Ware08]. The designer seeks a fresh approach to the problem and discovers the relevant entities and relations that emerge from his observation, and which are useful to his purposes. Both the requirements and the design solutions become more refined as the design process proceeds.

The computer opens a new horizon in visual creation and is an occasion for the designer to redefine his traditional principles of design. The challenge for modern design process supported by computer is to visualize concepts that are assumed to exist in a given design domain and relations that hold among them during design process. Both concepts and relations lead to computational ontology [GuOS09].

Often, design ideas are visualized by means of diagrams. Components of diagrams can convey precise meanings. Examples are transistors and resistors in circuit diagrams, doors and windows in architectural drawings. Any specialized field typically has its own set of conventions of diagram construction, i.e., a vocabulary being a finite set of *visual elements* such as dots, segments, geometrical figures etc. and a finite set of rules specifying possible configurations of these visual elements. The vocabulary and the set of rules define a *specialized diagram language*.

This paper proposes an ontology of creative visual design aided by computer consisting of three key concepts: a *design task*, a *visual site*, an *physical design action*, and additionally a *data structure* – helpful to support design process by computer. Each design task is expressed in terms of requirements which are modified during the design process. A visual site is defined as

a diagram along with a surface on which it is drawn. Two different diagrams on the same surface, e.g., on the sheet of paper or on the monitor screen determine two different visualization sites. A physical design action is one of such operations as drawing, copying and erasing visual elements. A data structure represents a diagram of an appropriate visual site [Grab07].

The considered ontology gives the categorization of sets of design tasks, visual sites and actions with the use of the notion of classification. The ontology contains two relations: a *semantic convention* and *signalling*. The former is defined as a relation between constraints on visual sites and constraints determined by designer's requirements. The latter is based on visual perception and determines visualization sites used to find a design solution [Shim96]. These two relations specify the first level of an ontological commitment between designer's requirements and visual sites. The second level of the commitment is related to computer readability of externalization of designer's ideas on the visual site and is defined by means of the mapping between elements of the specialized diagram language and a data structure representing these elements. The data structure stores design knowledge in the form of diagram components and relations between them. Finally, the third level of the ontological commitment is associated with automatic reasoning and is given by means of the mapping between elements of the vocabulary of the first-order logical language and entities of the data structure.

On the basis of the described ontology a computer-aided visual design system has been developed [BGGP11]. In this system diagrams created by the designer on the monitor screen are automatically transformed into graph data structures. The ontological commitments allows the system to transform semantic and syntactic information encoded in the data structure representing drawings into logic formulas. The formulas store knowledge about created designs and enable the system to reason about compatibility of design solutions with specified constraints [Grab10]. The figures in examples illustrating the approach considered in this paper come from this system.

1. Computer Aided Creative Visual Design System

The target of designing is the object, called the *design task*, created by the designer during the design process. This task is formulated in terms of design requirements. At the beginning only initial requirements are specified. During the design process the new requirements are added. A classification of design tasks allows one to describe designer's refinement of requirements.

Def. 1. *A classification of* ***design tasks*** $C_T = (D_T, \Sigma_T, |\!\!-_T)$ *consists of:* ***1)*** *a set* D_T *of design tasks to be classified,* ***2)*** *a set* Σ_T *of requirements used to classify the solutions, called the* ***types*** *of* D_T, ***3)*** *a binary relation* $|\!\!-_T$ *between* D_T *and* Σ_T.

If a design solution $t \in D_T$ is classified as being of type $\sigma \in \Sigma_T$, we write $t \; |\!\!-_T \; \sigma$ and say *t belongs to* σ. Design solutions of D_T can be classified by design requirements of Σ_T in the form of expressions of the propositional logic.

In our approach design process is described with the use of two environments: an *internal* and *external* worlds. The classification of design tasks is related to the internal world and is modified during the design process. When the designer determines design goals and requirements then conceptual actions are undertaken. Physical design actions express externalization of designer's internal world and connect the two worlds. In visual design supported by computer, designer's visual site can be a monitor screen on which diagrams are created and automatically transformed into data structures.

Def. 2. *A classification of* ***visual sites*** $C_V = (D_V \times D_S, \Omega_V \cup \Psi_S, |\!\!-_V)$ *consists of:* ***1)*** *a set* $D_V \times D_S$ *of pairs* $(\mathbf{v}, \mathbf{s})$, *where* **v** *is a visualization site and* **s** *is a data structure representing a diagram of* **v**, ***2)*** *a set* $\Omega_V \cup \Psi_S$, *where* Ω_V *is a set of types used to classify the visualization sites of* D_V, Ψ_S *is a set of first-order logic formula supporting the classification of the visualization sites on the basis of data structures of* D_V, ***3)*** *a relation* $|\!\!-_V$ *between* $D_V \times D_S$ *and* $\Omega_V \cup \Psi_S$.

If a visual site $v \in D_V$ is classified as being of type $\rho = \omega \wedge \psi$, where $\omega \in \Omega_V$, $\psi \in \Psi_S$, we write $v \; |\!\!-_V \; \rho$ and say *v belongs to* ρ. The designer obtains information about the design situation from a visual site using perception. If a visual site v is used to find a design solution t, then we say that *v signals t,* $(\mathbf{v} \rightarrow \mathbf{t})$, where $\rightarrow$ is a binary relation from D_V to D_T . Designer's requirements can be treated as constraints on expected design solutions. Forms of visual constraints on the diagrams in the domain of visualization sites are different from forms wherein the designer expresses requirements related to the design tasks in his internal world. When taking physical actions he encodes information about the object being designed in the fictional depicted world. He also deals with visual organization of the diagrams, which includes form, proportion, line, shape and so on. Using the specialized diagram language, the designer tries to find commitment between diagrams created by him and his requirements. Therefore types of $\Omega_V \cup \Psi_S$ that classify visual sites must be related to types Σ_T that classify design solutions. The correspondence between these types is expressed as a binary relation => from $\Omega_V \cup \Psi_S$ to Σ_T, called a *semantic convention*. It relates constraints on diagrams to designer requirements. It is worth noticing that signalling relation and semantic convention together form a map-

ping from the sets of classification of visualization sites to the sets of classification of design tasks. This mapping describes the ontological commitment between visual sites and design tasks in a formal way.

The types of Ω_V associated with visual sites are related to geometrical properties of diagrams: appropriate geometrical shapes and their transformations which allow for obtaining admissible components of design solutions. The types Ψ_S of classification are done automatically by the design system using sentences of the first-order logic. These sentences form design knowledge related to the visual site diagrams and are evaluated on the basis of data structures corresponding to these diagrams.

Recently, visual design process is often treated as a sequence of actions, which changes the external words. These actions called physical design actions consist in drawing, copying and erasing visual elements of diagrams. They can be treated as a certain kind of events in the external world that start with an initial situation and result in another situation.

Def. 3. *A classification of* ***physical design actions*** $\mathbf{C_A = (}D_A, \Delta_A, |\!-_A\mathbf{)}$ *consists of:* ***1)*** *a set* D_A *of physical actions to be classified,* ***2)*** *a set of types, of* Δ_A *and* ***3)*** *a belonging relation* $|\!-_A$ *contained in* $D_A \times \Delta_A$.

We define a tertiary relation $D_V \times D_A \times D_V$ denoted by $\rightsquigarrow$ and $v_i \rightsquigarrow^a v_o$ means action a has v_i as an *input* visual site and v_o as an *output* visual site. An output visual site presenting the final design solution is a result of sequences of actions. We introduce an operation $\bullet$, called *composition* on the set D_A of actions, which is closed under $\bullet$. For all actions a, a' in D_A and for all visual sites v, v' in D_V the composition $a \bullet a'$ is defined by means of an extension relation $\rightsquigarrow$ with the input visual site v and with the output visual site v' defined in the following way:

Def. 4. $v \rightsquigarrow^{a \bullet a'} v'$ *iff there is* v^* *in* D_V *such that* $v \rightsquigarrow^a v^*$ *and* $v^* \rightsquigarrow^{a'} v'$.

A formal definition of Computer Aided Creative Visual Design system (**CACVD-system)** sums up the discussion:

Def. 5. *A* ***CACVD-system*** *is a 5-tuple* $\mathbf{D = (}C_T, C_V, C_A, \Rightarrow, \longrightarrow\mathbf{)}$, *where:*

- $\mathbf{C_T} = (D_T, \Sigma_T, |\!-_T)$ *is a classification of design tasks,*
- $\mathbf{C_V} = (D_V \times D_S, \Omega_V \cup \Psi_S, |\!-_V)$ *is a classification of visual sites,*
- $\mathbf{C_A} = (D_A, \Delta_A, |\!-_A)$ *is a classification of physical design actions,*
- *Relations:* $\Rightarrow$ *is a semantic convention, and* $\longrightarrow$ *is a signalling.*

The **CACVD**-system allows one to describe a manner in which the designer thinks about design problems. There are two major categories of thinking: *divergent* and *convergent* [Laws01]. Divergent thinking is imaginative

and intuitive, whereas the convergent one is logical and rational. The explanation of design creativity on the base of a cognitive theory of memory patterns processing visual stimuli contains the hypothesis that creativity involves the capacity to spontaneously shift back and forth between analytic and associative modes of thought according to the situation. Therefore thought is triggered by stimuli, which activate memory in specific patterns that support divergence or convergence [Gold10]. Taken as a whole, design is a divergent task. However, during the process of creative design good designers are able to develop and maintain several lines of thought, both convergent and divergent. The divergent task for designer's mind is an open-ended approach seeking alternative.

Def. 6. *Let* $\mathbf{D} = (\mathbf{C_T}, \mathbf{C_V}, \mathbf{C_A}, \mathbf{=>}, \longrightarrow)$ *be a* ***CACVD*** *model and* $\sigma_1, \ldots, \sigma_n$ *be a sequence of types classifying design tasks of* D_T, *and* $=>$ *be a semantic convention. The model* ***CACVD imposes divergence*** *on the types* $\sigma_1, \ldots, \sigma_n$ *iff there exists an input visualization site* v_i *in* D_V *and a sequence of actions* $a_1, \ldots, a_m$ *in* D_A *such that:*

1. *The types* $\sigma_1, \ldots, \sigma_n$ *allow the composition action* $a_1 \bullet \ldots \bullet a_m$ *on the visual site* v_i.
2. *The output visual site* v_o *for the action* $a_1 \bullet \ldots \bullet a_m$ *allows new types* $\omega_1^*, \ldots, \omega_k^*$ *in* Ω_V *for* $k > 1$ *such that* $v_o \mid\!-_V \omega_i^*$ *for all* $i = 1, \ldots, k$.
3. *On the semantic convention* $=>$, *each type* ω_i^* *confirms a type* σ *of* Σ_T *or/and indicates a new type of* Σ_T.

In other words, the composition of actions $a_1, \ldots, a_m$ leads to the output visualization site which allows the designer to discover new facts. Each of these fact can inspire the designer to perform one of alternative actions or to formulate a devised requirement. The convergent way of thinking can be defined in an analogical way.

2. Application

On the base of **CACVD**-system, a computer system supporting the conceptual visual phase of design has been implemented [PaGG11].

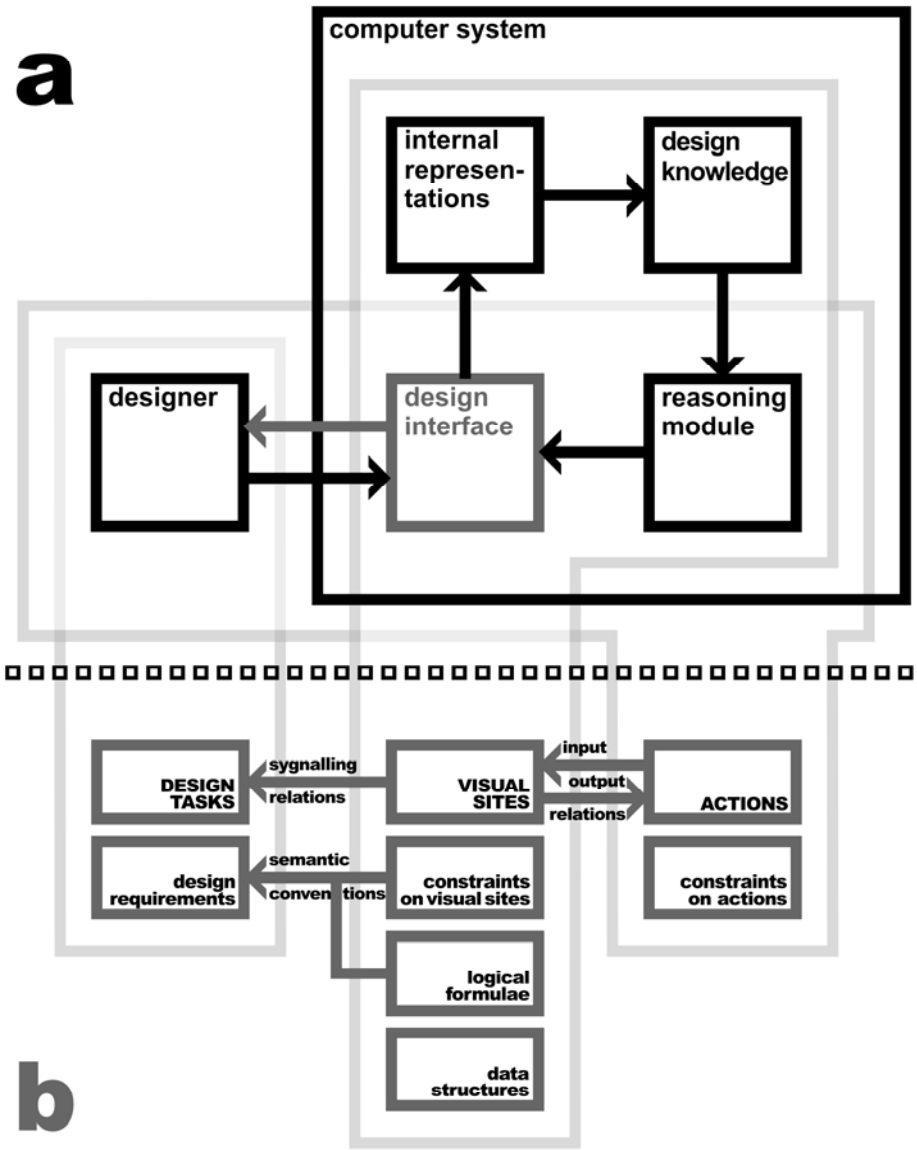

Figure 1. A computer system based on CACVD-system: a) a schema of visual design computer system, b) key concepts and relations of the formal model

Figure 1 shows relations between the designer with the computer system and components of the **CACVD** system. Polygons with grey sides represent common areas. This system makes it possible to extract design knowledge from the early design solution created in the form of diagrams. This knowledge is used to support rapid decision-making throughout the design process. All designer's actions on the monitor screen are transformed into appropriate modifications applied to data structures corresponding to the diagrams and then translated into logic formulas. The proposed logic-based reasoning mechanism enables the system check whether design satisfy specified constraints.

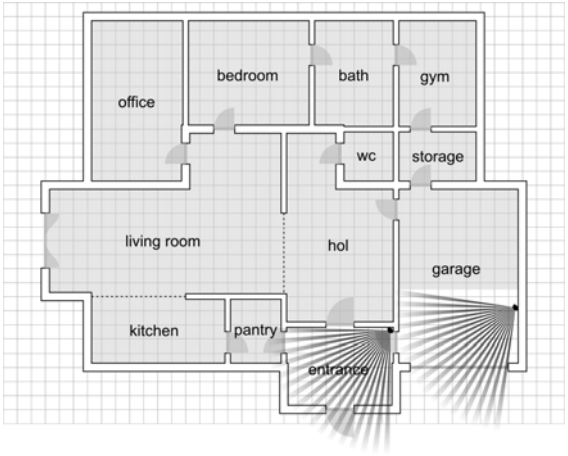

Figure 2. The floor-layout with unprotected areas indicated by grey colour

To illustrate the proposed model tests related to floor-layout designing have been created. One of them concerns the floor layout of single-family house in which all external doors should be surveyed by motion detectors. Let us consider the floor layout presented in Figure 2. Grey areas in this project shown rooms which are not monitored. Black shapes located on the figure represent motion detectors, while circle sectors correspond to spatial ranges of motion detectors. These sectors are not drawn by the designer, but they automatically generated by the system on the base of graphical symbols drawn by him on the diagram. The grey area without monitoring is also determined in automatic way. There exists the designer – system cooperation. In the next step the designer can add a motion detector enabling to monitor remaining areas. He can place the motion detector in different places.

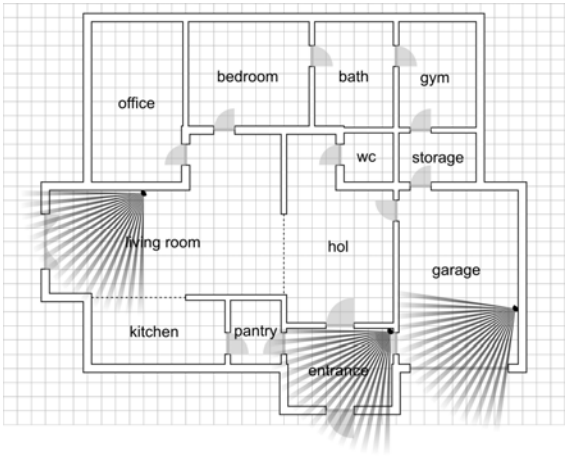

Figure 3. The first admissible design solution

Figure 3 and Figure 4 present two possible solutions. It is an example of divergent way of thinking.

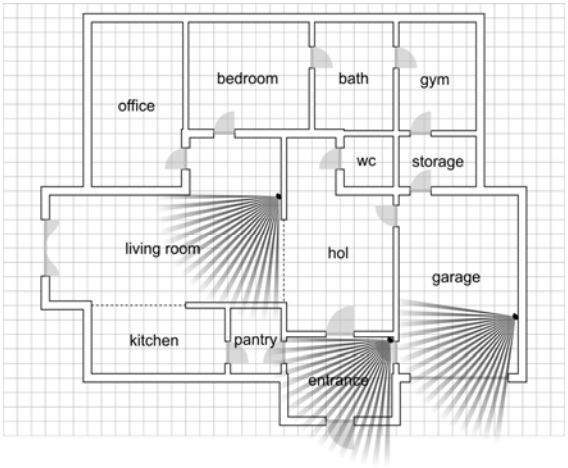

Figure 4. The second admissible design solution

Conclusion

CACVD-system presents significant aspects of visual creative design process, which are necessary to devise computer aided design systems and new computer cognitive tools. Moreover, the new framework for design allows one to hold concepts from different disciplines (computer science, mathematics, engineering and psychology) in a formal way and shows influence of different perspectives on the design creativity.

Literature

[BGGP11] Bhatt M., Gajek S., Grabska E., Palacz W.: Artefactual Reasoning in a Hypergraph-Based CAD System. In: Computer Recognition Systems 4, AISC 95. Eds. R. Burduk et al. Springer-Verlag, Berlin, Heidelberg 2011.

[Gold10] Goldschmidt G.: Ubiquitous Serendipity: Potential Visual Design Stimuli Are Everywhere. NSF Workshop: Studying Visual and Spatial Reasoning for Design Creativity. Pre-Workshop Paper, Aix en Provence 2010.

[Grab07] Grabska E.: Visual Design Aided by Computer (in Polish). EXIT, Warszawa 2007.

[Grab10] Grabska E.: Visual Design with the Use of Graph-based Data Structure. In: eWork and eBusiness in Architecture, Engineering and Construction. Eds. K. Menzel, R. Scherer. London 2010.

[GuOS09] Guarino N., Oberle D., Staab S.: What Is an Ontology? In: Handbook on Ontologies. Eds. S. Staab, R. Studer. Springer, 2009.

[Laws01] Lawson B.: How Designers Think: The Design Process Demystified. Butterworth Architecture, Oxford 2001.

[PaGG11] Palacz W., Grabska E., Gajek S.: Conceptual Designing Supported by Automated Checking of Design Requirements and Constraints. In: Improving Complex Systems Today. Eds. D. Frey et al. Proceedings of the 18th ISPE International Conference on Concurrent Engineering, Springer, London 2011.

[Schi96] Shimojima A.: Operational Constraints in Diagrammatic Reasoning. In: Logical Reasoning with Diagrams. Eds. G. Allwein, J. Barwise. Oxford University Press, Oxford 1996.

[Ware08] Ware C.: Visual Thinking for design. Elsevier 2008.

Streszczenie

Artykuł rozważa problemy związane z kreatywnym projektowaniem wizualnym wspomaganym komputerowo. Zdefiniowano w nim ontologię tego typu projektowania stanowiącą bazę modelu formalnego. Przedstawiono prototypowy komputerowy system wspomagający projektowanie wizualne zbudowany na podstawie tego modelu. W systemie projektant tworzy wstępne rozwiązania projektowe w postaci rysunków na monitorze, które są automatycznie tłumaczone na grafowe struktury danych. W następnym kroku wiedzę otrzymaną ze struktury danych wykorzystuje się do oceny rozwiązań projektowych.

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Eugeny Starikov
Vladimir Pshenkin
Vlad Bulatov

Lomonosov Moscow State University

CORE COMPONENT DATA INTEGRATION

Introduction

Information technology in the public administration is widely used today. Most processes of public administration are cross-departmental and providing e-services requires high level interoperability. For efficient interagency connections it is necessary to create a separate Data Exchange Center – a repository for implementation of two functions: data schema integration and data warehouse for original dictionaries integration and links to local information systems dictionaries. There are some methods to integrate systems. The article presents an application for dictionary data integration. The application is based on modification of ER models. A next step of work is data integration by ontological methods.

Information system architecture for cross-department data exchange

Information system architecture for cross system interaction can be realized by wrappers, providing interoperability between two systems (Figure 1). If we need to integrate set of systems, the way of wrappers for each pair of systems is very expensive.

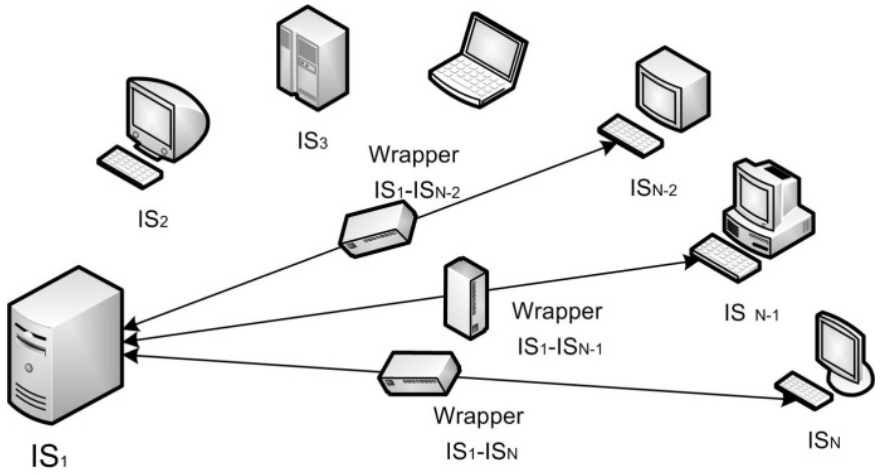

Figure 1. Wrappers integration

Source: [Lipu10].

The other way of integration is to implement Enterprise Service Bus, which can organize interaction with every system. This variant suggests the data integration of every IS with any other IS and this type of architecture allows to connect the new information system (Figure 2).

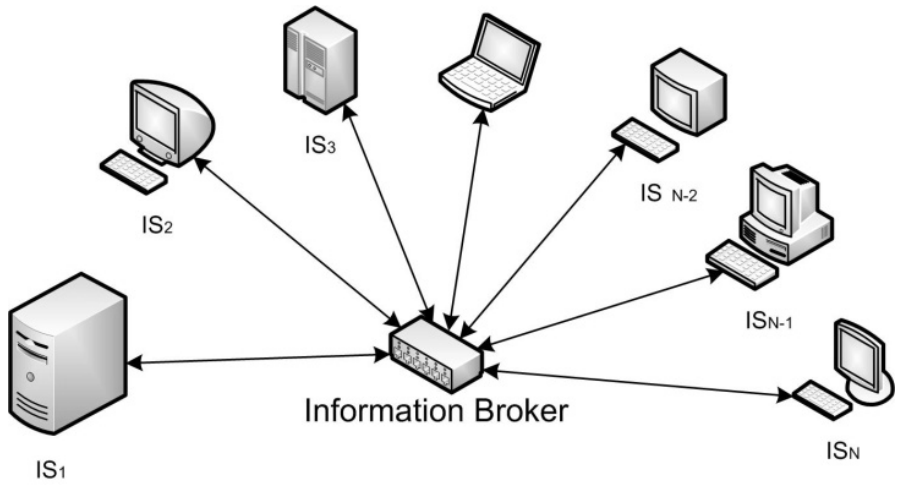

Figure 2. Information broker integration

Source: [Lipu10].

Main element of this architecture is an information broker that coordinates activity of applications and data exchange and provides the services:

1. Messages and data exchange transport and delivery messages to applications, using Internet protocol HTTP, messaging systems and XML.
2. Message Routing defines a list of applications for each message. Routing can be is realized on "publication and subscriptions" method: server application publishes the event and business applications subscribe to message.
3. Transformation assumes unification data format. This semantic data harmonization can be performed within an application or between applications.
4. Execution as specified set of operations: messages, routing and transformation which can be run automatically. This type of services like to business processes management system. Information broker can monitor and analysis automated business processes.

For different applications and data formats information broker contained set wrappers:

- wrappers for web services,
- wrappers for transactional systems,
- wrappers for relational databases,
- API – wrappers for popular applications.

e-Government infrastructure as data integrator

Infrastructure of e-government can be defined as unified information system for exchange data and technologies and provide services access for citizens and business by universal interface independent on service type: one or multiple agencies.

Regional or local service provider has following difficulties for IT development:

- the impossibility to get proper funds for the realization of innovative processes,
- the lack of adequate skills to support innovation,
- the lack of a proper technological infrastructure.

For effective service providing government need to create a powerful infrastructure, to shift the development and adaptation activity from the local information systems to infrastructure.

Infrastructure for services providing is analog to outsourcing service delivery, when some steps are performed by external service providers. This allows improving the internal efficiency of government agencies and increasing quality the monitoring and control services. Infrastructure performs in storage, data conversion and processing. Departmental applications within the infrastructure carry out specific functions, using common directories, Web services, digital signatures, e-payment systems, etc. (Figure 3).

The Russian government has defined Core component registers* that will be used for municipal or public services. The list of federal level registers include name of registers and authorized body:

- taxpayers register,
- real estate cadastre,
- company register,
- real estate rights and transactions register,
- motor vehicles register,
- address register.

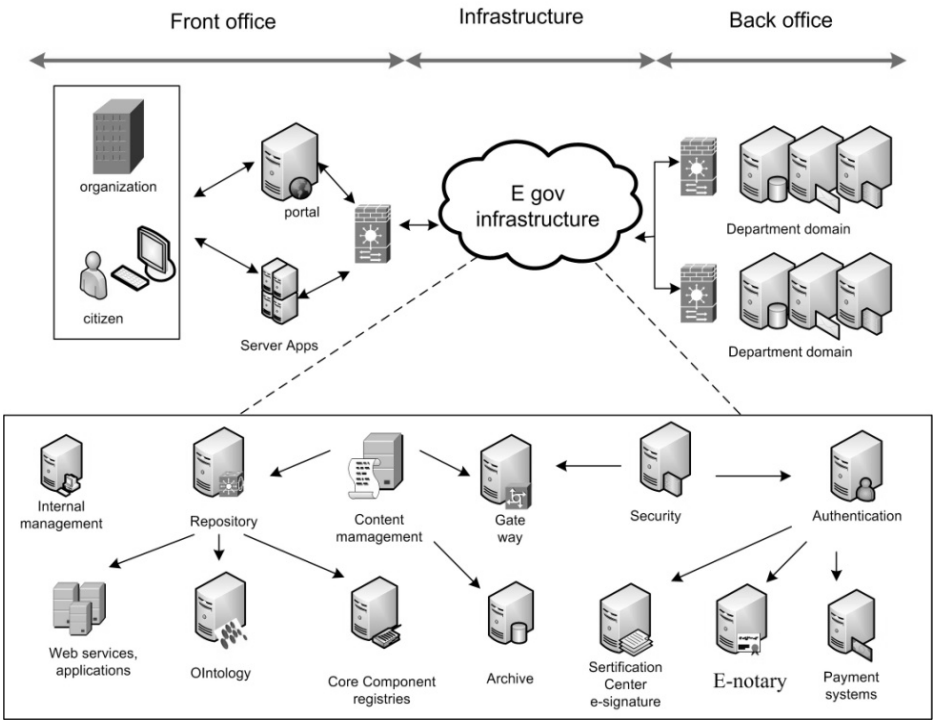

Figure 3. Infrastructure elements for e-gov services

Source: [Lipu11].

* Russian Federation Government Decree of 15.04.2011 N 654-p "The basic state information resources".

The list of competent agencies includes Pension Fund, Federal Tax Service, Rosreestr, Federal Migration Service, Internal Affairs Ministry. Every department has to update and provide access to register data for interested departments or users.

According to this document every local organization need to create wrappers to individual register and the responsibility of this lays on the local systems administrations. This model of interagency cooperation likes scheme shown in Figure 1.

To other type of integration by integrating bus requires organization of central point for interactions as infrastructure part of e-government. Technological changes will migrates data schemas, protocols, data access etc and all this movements should be monitored by local systems administrators. Adaptations and follows to changes will be significant part of the local IT budgets.

Creation the Center for Core Component data integrations is question of time, in one side because it is natural way for interoperability, and the second – information correctness: any register do not have full information about core component. For example, voters register – as the register – federal aggregated database of natural persons has information about voters but this registry don't contained data about some part of population, because originally this system has been focused for local decisions – list of voters only. The same problems may be in the other registers.

Directories for e-government applications

Two types of dictionaries

In government information systems there are two types of directories: linear and hierarchical. The two types differ by roles of operators at local and regional levels.

For example, in information system "Voting" dictionaries "last names", "names", "patronymic", etc. is a linear type. System has 4 levels: federal, regional, municipal and local. Users of the lower level can add „unconfirmed" values, and federal level may approve new records. Territories dictionary is a hierarchical classifier. New record of this registry can be added on any level and approved by next level.

Every federal level register is a complicated system. Conceptual schema data registry of voters (PRUIR) (Figure 4) show than the integration of department information system with such system is a not simple task.

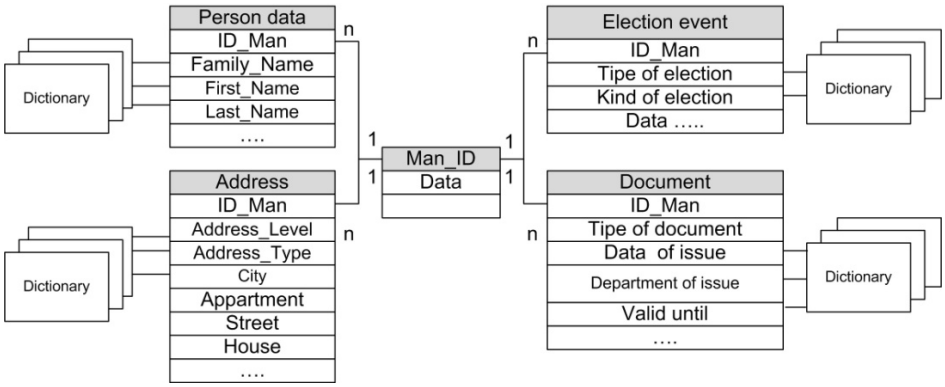

Figure 4. Conceptual data schema of PRIUR

Source: [Lipu].

For local application we need a unique connection to the register. All changes in the original registry need replication on the neighboring system. Stakeholder of the registers has to initiate the replication to the local system. Obligation to do the replications of changes of registry cannot be on the department, therefore need environment for performance all activity of Core component directories.

The design of architecture integrating system has two types: Global as View and Local as View.

The first one (Global as View) is used when all data sources are known. Data access to local systems can be implemented by mapping the user's request into set of sub-queries to local data sources, or as a request to integrated data.

The second architectural type (Local as View) allows the dynamic composition data sources, and new data source can be connected.

The basic elements of integration environment

The tools for integration of information resources include two part: integration tools for metadata and data integration tools as warehouse (Figure 5). These tools include Wrappers, Mediators and a tool for schemes integration and ontological specifications integration. Results of integration are presented to the user metadata access and data access.

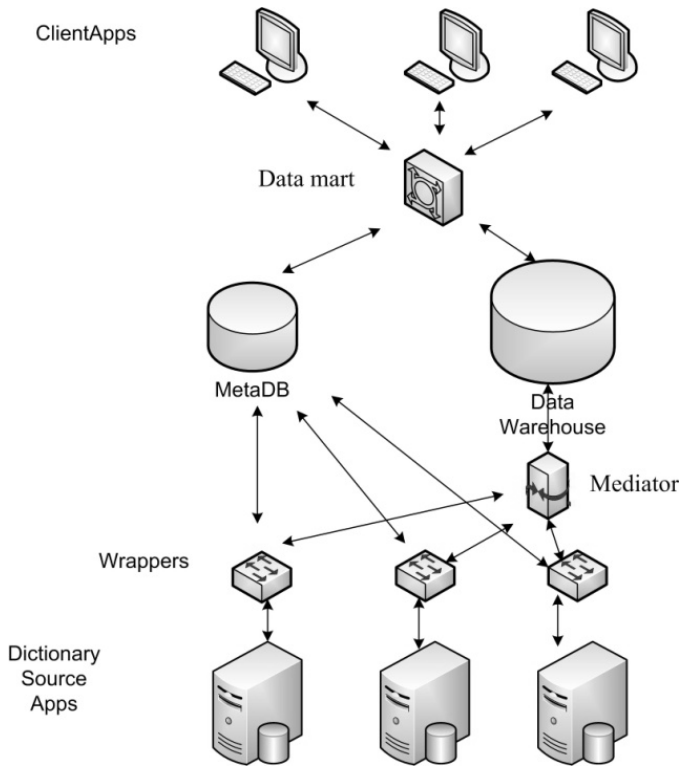

Figure 5. Two parts of the system Integration: Metadata and Data Warehouse

The integration process can be represented in the following sequence of actions [BaVi]:

1. Produce basic schemas.
2. Cluster schemas in groups, using areas of interests.
3. For each cluster of schemas, produce an integrated/abstracted schema.
    a. Integration:
        - pairwise comparison of input schemat:
            - name conflict analysis,
            - structural conflict analysis,
        - production of amended schemat,
        - production of the integrated schema,
        - inclusion of interschema properties.

b. Abstraction.

Important part of data integration is the metadata integration. Main step in process of data integration is mapping: matching data schema source and target system. It is necessary for every data source to define a set of rules for conversion data from one system to another.

Set of difficulties in mapping can be present as list of conflict, for example [Koga]:

- heterogeneity conflict (using different data models of sources),
- naming conflicts (different terminology in different schemes),
- semantic conflicts,
- structural conflicts (the same entity are presented in different sources and data structures).

One problem of integration – connection of the ontology specified resources.

The open data in public administration are present the integration of public data on base metadata [Peri; Cyga]. For this are requested description of data source by ontological model. The repository is collection data models at the metadata level (Figure 6).

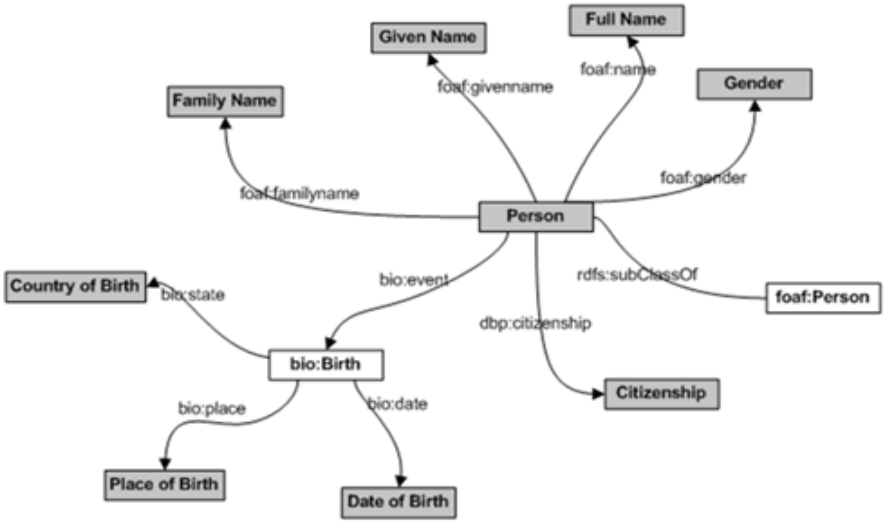

Figure 6. Identification of a person in eGovernment context, based on the evaluation of four assets (Person models of Austria, Denmark, France and Germany)

Source: [Peri].

Core component data integration by metadata is possible if you do not need personal data and aggregate form is enough.

For example, the regional education department forecasts the number of students the medium term or pension funds need information about pensioners. In these cases we can use aggregated data. If we are going to take decision by individual objects: persons or company, real estate there is a need for unique identification.

Integration environment

At the Economic Faculty Lomonosov Moscow State University was project data integration as a result of which was created integration environment. Main components of the integration environment are shown in Figure 7.

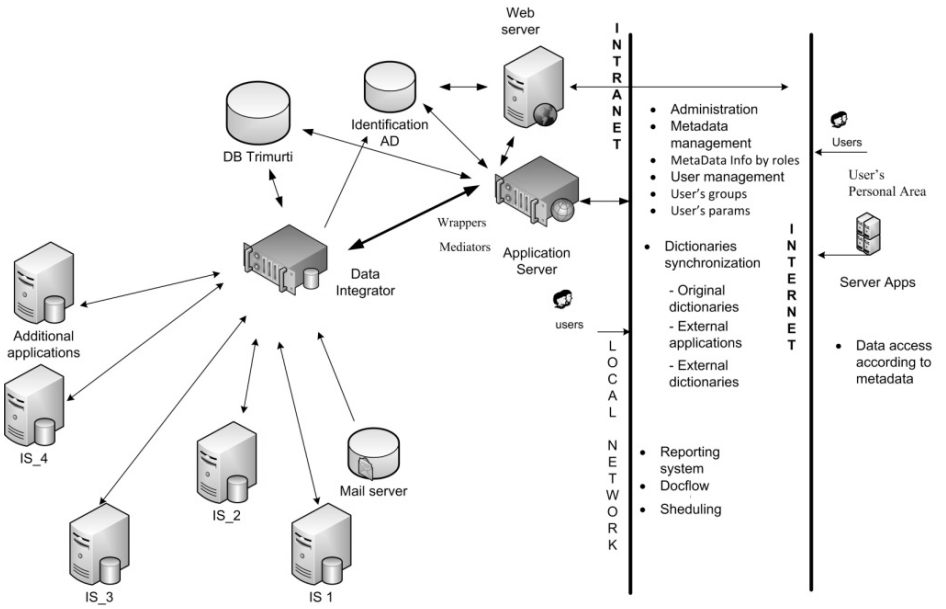

Figure 7. Scheme Environment integration

Connection of original dictionary records with local dictionary was realized by X-Link table (Figure 8).

For each record every dictionary created the atom in Table X-Atom. This record is associated with the records of local dictionary by X-Link table, were reflected the application ID and dictionary ID.

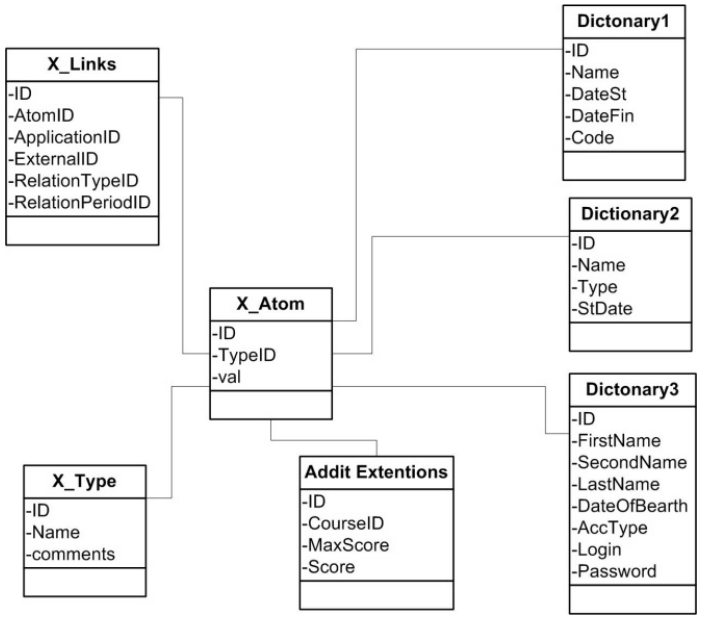

Figure 8. Conceptual diagram of the integration environment data

Detail of connection defined in X-type table, which consist the connection time and other attributes of association local records with original. This type of dictionary links allows creating flexible tool for data sets operations. Data exchange between the application server and the Web server is implemented using a metadata transfer in XML.

Further steps

Most information systems of public administration have been developed on relational databases. Subject area described by data model based on ER-diagrams. Business model is transformed in ER-model into entities, re-lationships and attributes. Semantic domain can be presented separately. The semantic model introduces the term of subject area and determines value by relationships and constraints. This presentation level is like ontological model.

Publications [Koga10] has a description of how the relational data model can be transformed by descriptive logic to ontological model. It should be noted that the ontological modeling as a method of data integrating is considered by many authors as perspective.

Literature

[Allf] Allford R.: Schema-Less Data Integration. rory.allford.net/wp.../04/Rory-Allford-Schema-Less-Data-Integration.pdf

[BaLe] Batini C., Lenzerini M., Navathe S.B.: A Comparative Analysis of Methodologies for Database Schema Integration. "ACM Computing Surveys" 1986, 18 (4).

[BaVi] Batini C., Viscusi G., Barone D.: A Repository Based Approach to Data Reverse Engineering. citeseerx.ist.psu.edu/viewdoc/download; doi = 10.1.1.98.1281

[Cyga] Cyganiak R.: State of Play in Linked Open Data. http://www.slide-share.net/init_brussels/cyganiakrichardstateofplaylod

[Faha] Fahad M.: ER2OWL: Generating OWL Ontology from ER Diagram. International Federation for Information Processing, Vol. 288. ISBN 978-0-387-87684-9.

[Gogu] Goguen J.A.: Data, Schema, Ontology and Logic Integration direct.bl.uk/ research/43/53/RN181357564.html

[Kalf03] Kalfoglou Y., Schorlemmer M.: Ontology Mapping: The State of the Art. "The Knowledge Engineering Review" 2003, 18 (1).

[KoFl] Kondylakis H., Flouris G., Plexousakis D.: Ontology & Schema Evolution in Data Integration: Review and Assessment. disi.unitn.it / ~ p2p/ RelatedWork/Matching/Kondylakis_ODBASE09.pdf

[Koga10] Kogalovskii M.R.: Methods of Data Integration in Information Systems. Electronic depositor Socionet, 2010.

[Lipu] Lipuntsov Y.: Core Component Case: Russian Voter Register. http:// www.semic.eu/semic/view/snav/Conformance/cases/ru-voter.xhtml?cid=1096277

[Lipu11] Lipuntsov Y.: The Institutions of e-Government infrastructure. Papers of the conference Lomonosov 2011.

[Lipu10] Lipuntsov Y.: Electronic Government: Models and Architecture. Moscow, TEIS 2011.

[PeBr] Peter Mc., Brien A.P.: Data Integration by Bi-Directional Schema Transformation Rules. portal.acm.org/citation.cfm? Id = 1783777

[Peri] Peristeras V.: SEMIC.EU: Towards Linked Government Metadata. http://www.slideshare.net/init_brussels/peristerasvassiliostowardslinkedgovernmentmetadata

[Riga] Riganelli O.: Shared Services Center for e-government Policy. egovinterop.eupm.net/cdrom/pages/presentations/43.ppt

[Schiel] Schiel U.: Interoperabilidade. www.dsc.ufcg.edu.br/~urlich/disciplinas/ Interop.ppt

[SoDo06] Solov'ev V.D., Dobrov B.V., Ivanov V.V., Lukashevich N.V.: Ontologies and Thesauri. Textbook, Kazan, Moscow 2006.

Streszczenie

Opracowanie zawiera propozycję autorskiego rozwiązania w zakresie integracji danych w Internecie na potrzeby administracji publicznej. Przedstawiono w nim architekturę rozwiązania i zaprojektowano sekwencje działań procesu integracji. Wskazano kierunki dalszych prac badawczych.

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Katowice School of Economics

PORTAL OF INNOVATIVE TECHNICIAN AS AN EXAMPLE OF FUTURE LEARNING

Introduction

In the era of technological progress all areas of science and work are increasingly focusing on the use of Internet resources. The world will be inhabited by people connected to the network [Kell98].

In more than ten years time information technology will become an integral part of personal and professional lives of the vast majority of people in our civilization. Without the basic skills associated with this technology, people will not be able to perform most jobs as well as acquire new qualifycations. Obtaining, elaborating and using information has become a part of common tasks at home and work [Mazu07]. Through interactive multimedia systems, developing countries can avoid the stage of industrialization [DryV99].

In the network virtual schools have been created and new methods and technologies for distance educators have been developed. The process of globalization of education is progressing, and the role of educational technology is increasing [StMS00]. The importance of change in the approach to education in the information society indicates that the issue of distance learning has become the subject of European policy and is reflected in the financial support of research projects aimed at developing a new paradigm for teaching [GołP04]. Therefore, the education has a major challenge: to make information technology a tool supporting teaching most subjects.

Tools offered by the technology should become a common means of teaching. School education can benefit from the opportunities offered by e-learning or educational portals. Many of the solutions from these forms of education assists traditional school lessons. We then have to deal with a hybrid learning, which brings together the advantages of traditional teaching and using information technology. Such a combination can reduce number of defects

in education. An example could be the lack of equal level of knowledge in the group. Therefore, the teacher directs to the so-called average student. The unit above the average and below average lose.

Another problem, in which modern technology can help is the lack of time during the course to provide the necessary knowledge and use it to perform various tasks and properly consolidate it. Therefore, the lessons are mainly used to transfer knowledge and develop skills, repeating and consolidating students do in their own time [Osin03]. These kinds of problems have one thing in common – they are difficult to solve within the traditional model of a lesson. That is why, it seems reasonable to refer to the computer support.

Knowledge discovery

Any discovery, invention or new idea, has been created as a result of creative features and creative human activity. Although people created techniques forcing creativity, it cannot be formulated in the form of an algorithm, always giving positive expected results.

We have many definitions of creativity, but everyone knows that creativity is the creation of new relationships with existing information coming from other sources.

From the psychological perspective:

1. Taylor said that creativity lets you combine pieces of knowledge up to create new more useful whole [Tayl98, p. 99-121].
2. Nęcka proposed definition that creativity is manifested in the form of behavior involving the production of new and valuable creations [Nęck05, p. 11-17].
3. Stein equates creativity with the process of leading to a new product that is accepted as a useful or acceptable for a certain group in a certain period [Stei53, p. 311-322].
4. Służewski, however, claims that creativity is a force, which becomes the cause of things not previously existing [StMS04, p. 587-598].

From an organizational perspective:

1. Leonard and Sensiper found that creative ideas develop through intellectual processes that analyze and make connections and links through which the information acquire new meaning [LeoS98, p. 112-131].
2. Smidt pointed out that creativity is the ability to associate things that seemingly have no connection, and thus obtain new solutions and new quality [Smid01, p. 57].

The definitions of creativity include many features in common. They can be included in the following overview which characterized the basic properties of creativity.

Characteristics of creativity:

- explore and create new things and phenomena, problem-solving in a unique way,
- supporting the creation and development of the related characteristics,
- identifying relationships between facts,
- independent investigation of truth,
- the development of hypotheses,
- no guarantee of obtaining the best solution.

Research on creativity also can be divided into several areas. Creative problem solving requires leaving the routine, which holds up the creativity, and focusing on innovation. This allows you to explore unknown things, phenomena, and create "new", for example, by detecting the characteristics that combine the facts, summarize them and developing them. You can also use the analogy, and solutions developed by others and improve them. But the best results can be achieved by supporting an independent investigation to find the solution, which not only gives satisfaction but also help – through the experience – in solving future problems.

Portal of Innovative Technician

A few decades ago it was enough that only 20 percent of the population had a higher education, 30 percent remained civil servants and craftsmen, and the remaining 50 percent were uneducated factory workers and farmers. Currently, the vast majority of students must be certain of their capabilities, independent and creative "managers of their own future". The revolution in the means of communication allows us to regularly update our knowledge and gives us instant access to information to all who have the tools.

We can therefore draw a lot of new models of behavior in the coming digital age. In the field of multimedia we should:

1. Use skills of the world's top experts in various fields.
2. Combine their talents with the skills of the best specialists in the field of simple, interactive and fun new teaching methods.
3. Add to that the best method of multimedia communication.

4. Make sure that all have immediate and free access to appropriate courses through the inexpensive network computer.
5. Install school intranets, which through a combination of the Internet make learning more enjoyable and more effective [DryV03].

A Portal of Innovative Technician has been created to provide students with the opportunities to grow and learn. On the website the student can gain knowledge of the technical and economic subjects. Classes, which until now could be exercised only in specialized and specific terms the student can perform at home using multimedia simulations. Portal consists of several modules that have knowledge of economics, electrical engineering, computer science. In addition, each module can be equipped with a program of recognition and speech synthesis. The portal can also be used to teach people with physical disabilities by installing a special keyboard to allow work on the computer.

The program also supports students' creativity. There is also an application that allows a dialogue with the computer. There are not many research on computer systems supporting creativity in use. Computer support system provides a decision-maker with models and data for the emerging ad hoc problem. Place, range and process of deciding should be discovered in the model [StaS01].

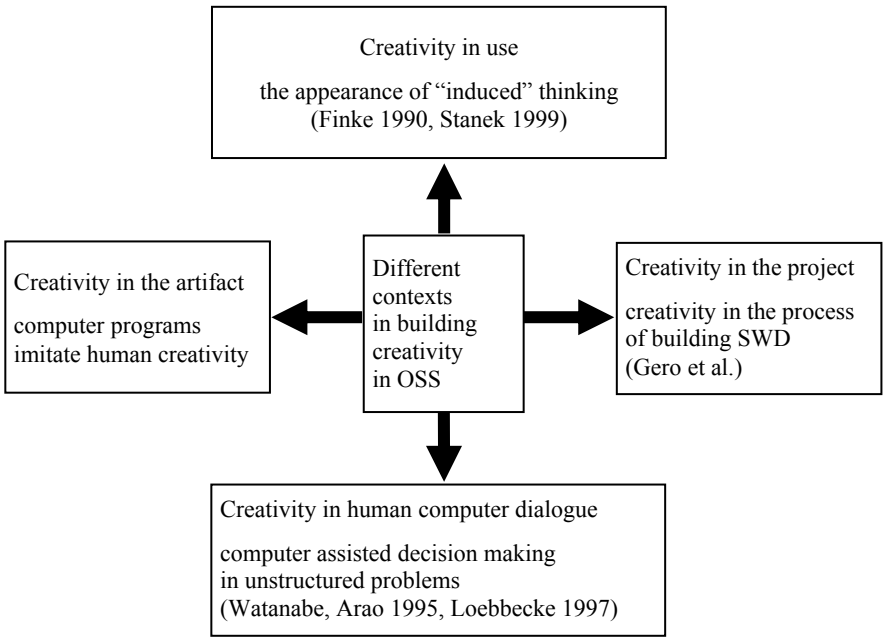

Figure 1. Types of computer systems supporting creativity
Source: [StaS01, p. 399-378].

Agent included in the application supporting the creativity helps students make decisions and supports creativity by pointing certain economic relations or with electrical engineering. Using this application, the student easier notes some links and relationships in the known themes developed in the portal.

Multimedia Laboratory of High Voltage

So far, it has only been possible to conduct the high voltage technical classes in a theoretical way or in few university laboratories. In view of the technical reasons as well as the safety rules and high costs, the construction of appropriate laboratory stands at school has been impossible.

Therefore an idea came up of creating a computer program which, as much as it is possible, would reflect the real measurement. Moreover, it would bring closer the phenomena which take place during discharge. The program could be used during the classes in technical laboratories and it would serve as an auxiliary device during the lectures. The work on the program has been preceded by a series of measurement conducted in a High Voltage Laboratory at Śląsk Polytechnic Electrical Department in Gliwice. Furthermore, a documentation of technical stands and practice instructions has been formulated. In order to present the most reliable simulation of the phenomena appearing over the real measurement, the sound effects have been recorded, which, in turn, have been used in the programme. Additionally, films presenting the discharge have been taped.

The Multimedia Laboratory of High Voltage enables:

1. Examination of the electrical resistance of the air in the system of single measurement, where all the activities connected with the measurement are conducted step by step so as to get the user aquainted with the mechanics of the stand and the observation of the discharge as well as the movement of electrodes in a way approximate to reality.in the system of measurement series, where the activities are mostly conducted automatically and in a raised pace so as to achieve the results as fast as it is possible. The results enable determining of the characteristics of the relation of Up voltage in the function of the distance between the electrodes of spark gaps Up=f(a).
2. On the stand, which serves to examine the electric resistance of the air, it is possible to conduct an examination using four sphere spark gaps.
3. Examination of the electric resistance of oil.

The aim is to get the user acquainted with dielectric properties of transformer oil as well as with the activities necessary to operate the stand, through the simulation of the way the ABO apparatus works.

The measurement series is consecutively conducted for five values of the electrode distance (1 mm, 2 mm, 3 mm, 4 mm, 5 mm) for which the Up voltage and the resistance is determined. Owing to that, it is possible to set

the characteristics of the relation of Up voltage in the function of the distance between the electrodes Up=f(a) as well as the characteristics of the relation of electric resistance in the function of the distance between the electrodes Ep=f(a).

On the stand, which serves to examine the electric resistance of oil, it is possible to conduct an examination using three kinds of electrodes:

- sphere electrodes,
- point electrodes,
- flat electrodes.

Simulation of atmospheric discharge as well as the possibility of getting the user aquainted with determining of the protective area of buildings, making use of lightning arrester tower.

The user has the possibility of arbitrary presenting of the electrode which functions as a storm cloud and a mock-up of the protected building(in the horizontal position). Owing to that, depending on the setting, it is possible to observe the following atmospheric discharge:

1. Towards the ground – when the distance of 'the electrode – storm cloud' to the building protected and the lightning arrester tower is greater than the distance of 'the electrode – storm cloud' from the ground.
2. Towards the lightning arrester of the building – when the distance of 'the electrode – storm cloud' to the lightning arrester tower and to the ground is greater than the distance of 'the electrode – storm cloud' to the protected building.
3. Towards the lightning arrester tower – when the distance of 'the electrode – storm cloud' to the protected building and the ground is greater than the distance of 'the electrode – storm cloud' to the lightning arrester tower.

Getting aquainted with the regulation which is obligatory in the Laboratory of High Voltage at English Department, the documentation of the measurement stand and the stand instructions.

All of the mentioned stands possess the electrical schemes of meter circuits.

The program facilitates the printouts of the characteristics and the achieved results.

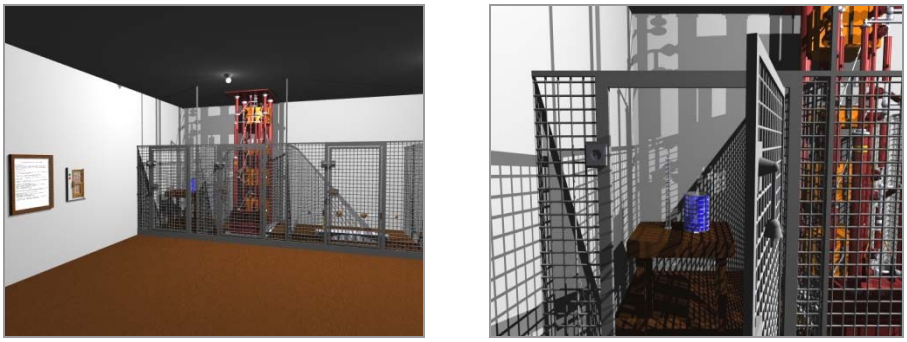

Figure 2. Multimedia Laboratory of High Voltage

Computer agent system which supports creativity in stock exchange decision making

Computer agent system which supports creativity in stock exchange decision making is made in order to investigate the possibilities of increasing human creativity using computer agent system.

The application consists of several modules that allow players to learn the rules of investment in the stock market. There is a module which collects data from stock exchanges delayed 15 minutes to the player. The user can use this module to buy virtual shares of companies listed on the stock for the amount of 100 000 zł (about 25 000 euros), create a share portfolio and manage them at his discretion. The program also includes basic information on stock investment, where the investor may seek knowledge.

Creative Agent program helps the user to select a listed company in which the player invests his or her virtual money. Agent asks questions and explains the user the intricacies of the stock market. The player talks to an agent and tries to choose the most favorable stock charts resulting from technical analysis.

Chart Generator helps select the companies in which it's worth to invest and promise the greatest profit. This program based on historical data, analyzes technical charts of listed companies and helps the user choose the best company to invest.

The system trains the advanced users and learners to make stock decisions. It can be used to teach investments on the stock exchange. Students can learn basic information about stock market. Advanced users can try to invest

and check new methods of investment without incurring a financial loss. You can also check the diversification of its share portfolio. The program can be used for training, simulation and decision-making on real stock market. There has been a research on supporting players' creativity using this program.

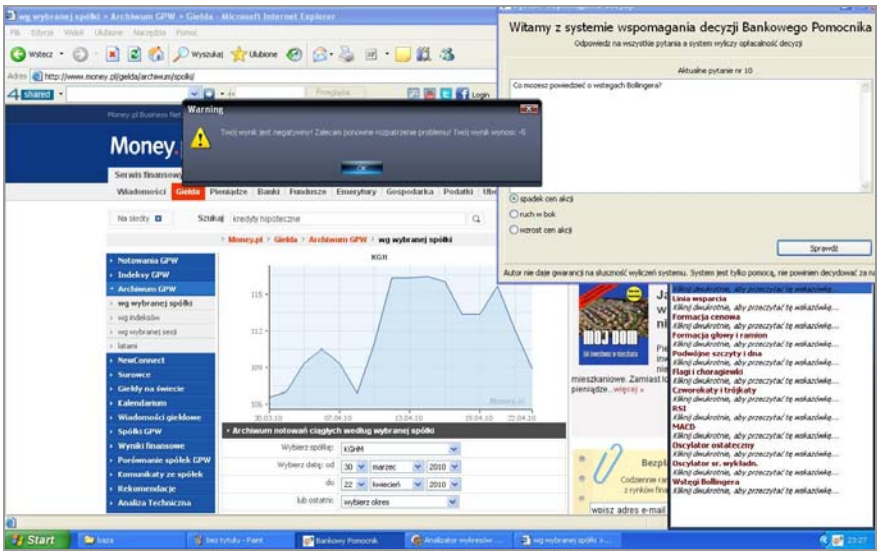

Figure 3. Computer agent system which supports creativity in stock exchange decision making

Your Computer Assistant – Future Computer

YCA FC is a project that exploits the rapid progress of innovation in information technology for serving the people. This is possible because its design is modular and its development is open. YCA FC can be employed in numerous practical applications for public, government, commercial and medical uses.

The main program is a platform that allows the use of speech recognition and synthesis combined with artificial intelligence in a simple way in any location. This means, among other things, that the computer can speak in human terms, as well as understand natural spoken language for any language – through the use of ready-made or custom solutions.

The project is focused on practical use, so the main program, YCA FC, can be very easily integrated with existing products (e.g. a game in which you can enter the voice control or dictation documents in a text editor)

The project consists of the main module YCA FC – it is the basis for all other activities. Other important parts are associated editors and software that allow people to extend the functionality of the project. The portal "YCA FC Market" combined with "YCA FC Developer Zone" is also critical. The portal enables a community of users that modifies and extends the project. At this point, users can add new modifications, as well as download existing ones.

Recent Case Studies

Case Studies:

1. "Electronic lessons". "Electronic lessons" is a modification prepared by Matthias Skórzańskiego. Teachers introduce a database through a simple interface. Then, students, who solve some problems or recall something from lessons, can ask the "electronic" teacher about certain details. An example dialogue: – I cannot find the area of two triangles – Calculate the area of each triangle and then sum them- What is the formula for the area of a triangle? – ***Triangle Area*** = ½b × h; b = base, h = vertical height.
2. "Project Life". "Project Life" allows paralyzed people to communicate with their environment. With a healthy part of their body they choose phrases that appear on the screen. Through connection with the YCA FC, all of these selected phrases can be "glued" to the sentences and read aloud by a synthesizer.
3. An interactive game. It is possible to use the program in the entertainment industr. For example, one possibility is to control the game using voice commands, and all the actions happening in virtual reality can be shown and read by the synthesizer.
4. InfoKiosk. An interesting commercial application of the program is a smart, modern information kiosk (i.e., an interactive information point, which is a type of electronic self-service). Using this application can eliminate the largest component – the monitor. The person seeking information just starts a dialogue, and the InfoKiosk will provide relevant information and guidance. Of course, you do not have to eliminate the monitor. The display could be used to show an animation of a person talking to the user of the InfoKiosk.
5. Guide. The program can be a guide – both in the virtual world as portal or software tool, as well as in the real world – e.g. directing tourists or giving instructions.

6. Reading. Reading different kinds of texts, such as forums, news, and books.
7. Prescribing. A very simple and practical example is transcription – turning voice into text. Transcription is useful when you need to write a long document, which can be made much faster through the use of dictation.

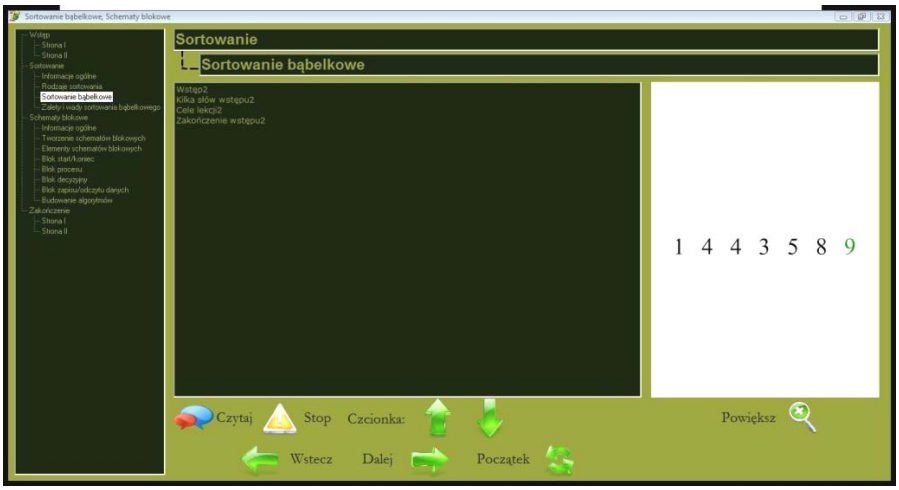

Figure 4. Your Computer Assistant – Future Computer

Life project

Through Life Project, those who have lost their voice and the ability to walk again, will be able to communicate with the environment.

The program is very easy to use. The patient uses two keys to scroll through the list of phrases, and the third to approve the chosen phrase, which will be displayed on the entire screen. If there is no one near the patient he may again press for approval key, the modulated tone recalling guardian will be played. By pressing any scroll key the patient returns to the list of phrases.

The software, in addition to a program through which the patient communicates with the environment, also includes programs for the guardian. They are: two editors, one – simple – used to add new phrases, and the other – advanced – designed not to only add new phrases, but also to modify, remove and set its priority. Guardian may also use the "configurator", which prepares the system to work with the program.

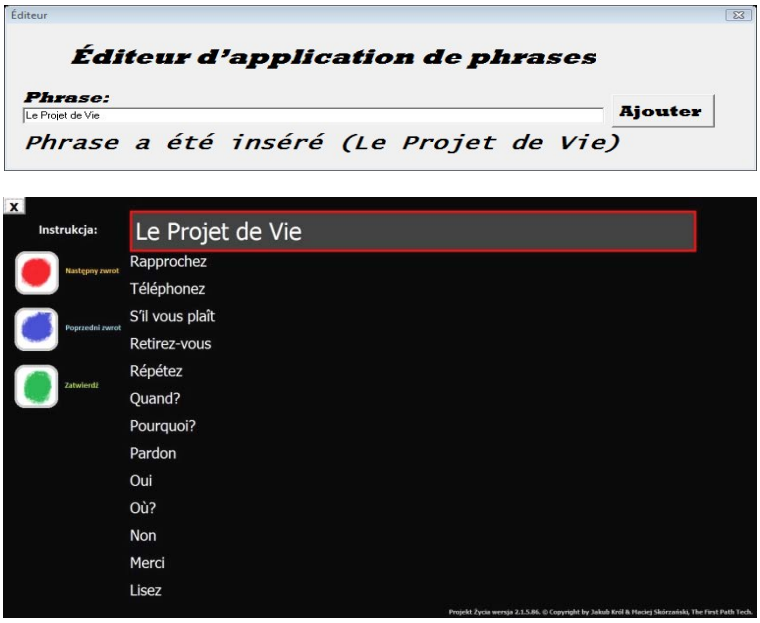

Figure 5. Life project

Conclusion

Currently the portal is available in beta version but it will be extended. In the future, it will support the teaching of technical subjects in high school and college. The application was presented at the International Innovation Exhibition INTARG in Katowice International Fair for Invention Research and New Technology in Brussels INNOVA and International Exhibition of Inventions – CONCOURS – LEPINE. The portal has been honored with numerous awards and medals.

Literature

[DryV99] Drygen G., Vos J.: The Learning Revolution. The Learning Web, Auckland 1999.

[DryV03] Drygen G., Vos J.: Rewolucja w uczeniu. Wydawnictwo Zysk i S-ka, Poznań 2003.

[GołP04] Gołuchowski J., Pańkowska M.: E-learning w szkoleniach pracowników i nauczaniu w szkołach wyższych. Rezultaty międzynarodowych projektów badawczych. AE, Katowice 2004.

[Kell98] Kelly K.: New Rules for the New Economy. Viking-Penguin, New York 1998.

[LeoS98] Leonard D., Sensiper S.: The Role of Tacit Knowledge in Group Innovation. "California Management Review" 1998, 40, 3.

[Mazu07] Mazur M.: Metody wykorzystania komputerowych programów wspomagających edukację szkolną. Warsztaty doktorskie '06 Zarządzanie – Finanse – Ekonomia. AE, Katowice 2007.

[Nęck05] Nęcka E.: Psychologia twórczości. Gdańskie Wydawnictwo Psychologiczne, Gdańsk 2005.

[Osin03] Osiński Z.: Możliwości jakie stwarzają platformy e-learning w edukacji szkolnej. Uniwersytet im. Marii Curie-Skłodowskiej w Lublinie, V Ogólnopolskie Forum Koordynatorów Technologii Informacyjnych, Mielec 2003.

[Smid01] Smid W.: Encyklopedia promocji i reklamy. Wydawnictwo Profesjonalnej Szkoły Biznesu, Kraków 2001.

[StaS01] Stanek S., Sroka H.: Building Creativity into OSS Design Framework. "Journal of Decision Systems" 2001, Vol. 10, No. 3-4.

[Stei53] Stein M.: Creativity and Culture. "Journal of Psychology" 1953, 36.

[StMS00] Stanek S., Mika J., Sroka H.: Inteligentna komputerowa gra strategiczna w Internecie. AE, Katowice 2000.

[StMS04] Stanek S., Mazur M., Sadecki B.: Zastosowanie kreatywnego agenta oprogramowania w module giełdowym IKGSwI wspomagającym inwestycje kapitałowe. In: Systemy Wspomagania Organizacji. AE, Katowice 2004.

[Tayl98] Taylor C.: Various Approaches to and Definitions of Creativity. In: The Nature of Creativity. Ed. R.J. Sternberg. Cambridge University Press, Cambridge 1998.

Streszczenie

W artykule opisano analizę przypadków komputerowego wspomagania kreatywności w szkole średniej. Przedstawiono kilka narzędzi wyróżnionych w konkursach międzynarodowych: INTARG Polska – złoty medal, BRUSSELS INNOVA Belgia – brązowy medal, Concourse Lepine Francja – brązowy medal.

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THE APPLICATION OF DATA MINING MODELS AND METHODS IN ENTERPRISES. REVIEW OF SELECTED FOREIGN FINANCIAL AND TELECOMMUNICATION INDUSTRY CASE STUDIES

Introduction

The contemporary organizations in order to gain competitive advantage have to apply modern technologies allowing for faster and better management of enterprise. Enterprises posses large amounts of data gathered in such repositories as databases and data warehouses. They must be able to transform the data they have collected into useful information in such a way that this information can be served for the enterprise's management purposes. It is difficult to understand information hidden in data without the aid of data analysis techniques. Different Data Mining models, methods, techniques and tools provide indispensable solution for this purpose. Collation and segregation of gathered data allows for drawing useful facts and conclusions and helps e.g. to improve efficiency and efficacy of undertaken in enterprises decisions as well as enabling performance of complex analyses which could not be conducted using merely statistical methods. The application of Data Mining in enterprises of different branches is broad and can also create new business opportunities.

1. Notion of Data Mining

Gartner Group defines Data Mining as "[…] the process of discovering meaningful new correlations, patterns and trends by sifting through large amounts of data stored in repositories, using pattern recognition technologies as well as statistical and mathematical techniques" [Laro05]. The term of Data Mining was also defined by Manila, Hand and Smyth as "the analysis of (often large) observational data sets to find unsuspected relationships and to summarize the data in novel ways that are both understandable and useful to the data owner" [HaMS01, p. 1]. Data Mining is a process that uses statistical, mathematical, artificial intelligence and machine learning techniques to extract and identify useful information and subsequent knowledge from usually large sets of data. It includes tasks such as knowledge extraction, data archeology, data exploration, data patterns processing, data dredging and information harvesting [TSAK08, p. 135-136]. Yao, Zhong and Zao distinguish three views of Data Mining: **the function-oriented view** which is concentrated on the discovery of knowledge from data, **the theory-oriented** view which focus on theoretical studies of Data Mining, and its relationship to the other discipline and **the process-oriented view** where DM consists of many steps such as data selection, data preprocessing, data transformation, pattern discovery, pattern evaluation and result explanation [LXWL08, p. 503-504]. The fundamental application of Data Mining is extraction of appropriate and useful information from data bases, data warehouses and other sources e.g. the Internet in case of Web mining. In this context "useful information" usually means some interesting information that realistically can only be found by analyzing the database with a computer and identifying patterns that an unaided human eye would be unable to ascertain [VoPo06, p. 291-316]. Data Mining practitioners and researchers have proposed a few approaches allowing for management of this process. One such a model is so called CRISP-DM model as acronym for Cross-Industry Standard Process for Data Mining, which was proposed in the mid 1990s by a European consortium of companies to serve as a nonproprietary standard process model for data mining. As it was showed on figure 1 it contains a sequence of steps for data mining projects [TSAK08, p. 155-156]:

Beside presented above model there exist projects based on SixSigma methodology such as DMAIC (Define, Measure, Analyze, Improve and Control), which apply measurement at each step and develop feedback mechanisms or SEMMA (Sample, Explore, Modify, Model, Assess) model proposed by SAS Institute. The architecture of a typical data mining system may have the following major components (Figure 2) [HaKa06, p. 8].

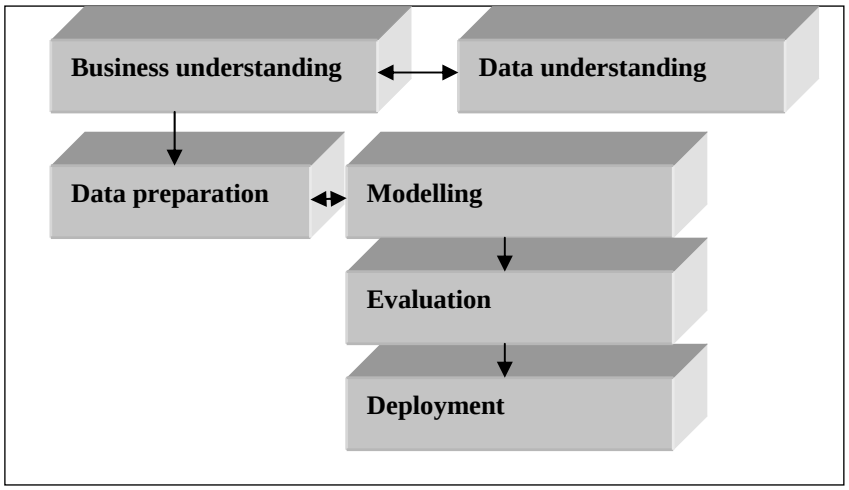

Figure 1. Data mining process according to CRISP-DM methodology
Source: [TSAK08, p. 156].

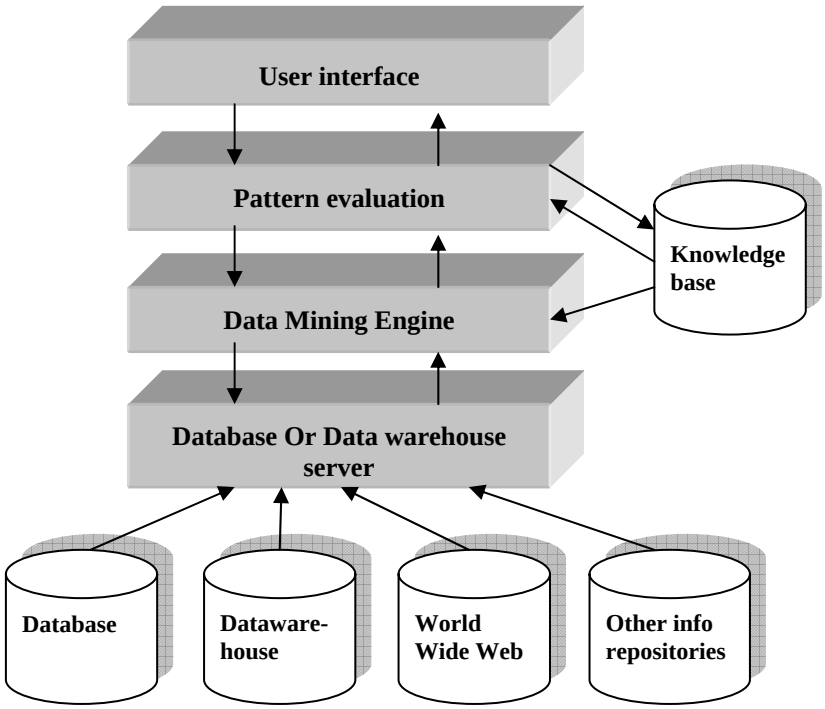

Figure 2. Architecture of typical Data Mining system
Source: [HaKa06, p. 8].

Database, data warehouse, World Wide Web or other sources of data constitute information repositories. Data cleaning and data integration techniques may be performed on the data. The database or data warehouse server is responsible for fetching the relevant data, based on the user's data mining request. Knowledge base is used to guide the search or evaluate the interestingness of resulting patterns. Such knowledge can include concept hierarchies, used to organize attributes or attribute values at different levels of abstraction. Knowledge such as user beliefs, which can be used to assess a pattern's interestingness based on its unexpectedness, and metadata e.g. describing data from multiple heterogeneous sources. Data mining engine consists of a set of functional modules for tasks such as characterization, association and correlation analysis, classification, prediction, cluster analysis, outlier analysis, and evolution analysis. Pattern evaluation module is a component which interacts with the data mining modules so as to focus the search toward interesting patterns. It may use interestingness thresholds to filter out discovered patterns. Alternatively, the pattern evaluation module may be integrated with the mining module, depending on the implementation of the data mining method used. User interface is a module which communicates between users and the data mining system, allowing the user to interact with the system by specifying a data mining query or task. This component allows the user to browse database and data warehouse schemas or data structures, evaluate mined patterns, and visualize the patterns in different forms [HaKa06, p. 9].

The research conducted among 34 international enterprises, showed that the application of Business Intelligence systems and Data Mining that is crucial component of such systems at the tactical level of management gave the following conclusions [ZIOR10]:

- BI system allowed for better prognoses of events scenarios,
- BI system accelerated execution of decision-information analyses in the scope of profitability,
- after implementation of BI system the ability to conduct loyalty and customer's analysis was improved,
- the application of Data Mining and OLAP enabled faster creation of prognoses and presentation of sales trends,
- after implementation of BI system the ability to measure profitability of customer and Life Time Value was improved.

At the strategic level of management Business Intelligence system accelerated execution of information-decision analyses in the scope of competetive analysis.

2. Characteristics of basic Data Mining models and methods

One of the most widely used data mining models and methodologies are: decision trees, association rules, artificial neural networks, statistical analysis of normal and abnormal data, Bayesian data analysis, Hidden Markov processes, Scalable clustering, nearest neighbour method, rule induction etc.

The **decision-tree** is a tree-shaped structure that represents sets of decisions and it the most widely used logic method. These decisions generate rules for the classification of a dataset. Specific decision tree methods include Classification and Regression Trees (CART) and Chi Square Automatic Interaction Detection (CHAID) used for classification of a dataset [Kant03].

Clustering is an unsupervised learning process that partitions data such that similar data items are grouped together in sets referred to as clusters. This activity is important for condensing and identifying patterns in data [PTMa08, p. 14]. Clustering also partitions state space, separating areas that have points sharing a common feature [Pyle99, p. 449].

Neural networks were developed to imitate the neurophysiology of the human brain through the combination of simple computational elements (neurons) in a highly interconnected system. P. Giudici states that "[…] a neural network is composed of a set of elementary computational units, called neurons, connected together through weighted connections. These units are organised in layers so that every neuron in a layer is exclusively connected to the neurons of the preceding layer and the subsequent layer". In his explanation of neural network functionality he states that every neuron, also called a node, represents an autonomous computational unit and receives inputs as a series of signals that dictate its activation. Following activation, every neuron produces an output signal. All the input signals reach the neuron simultaneously, so the neuron receives more than one input signal, but it produces only one output signal. Every input signal is associated with a connection weight. The weight determines the relative importance the input signal can have in producing the final impulse transmitted by the neuron. The connections can be exciting, inhibiting or null according to whether the corresponding weights are respectively positive, negative or null. The weights are adaptive coefficients that, in analogy with the biological model, are modified in response to the various signals that travel on the network according to a suitable learning algorithm. A threshold value, called bias, is usually introduced [GIUD03, p. 104]. In more formal terms, a generic neuron j, with a threshold θ_j, receives n input signals

$\mathbf{x} = [x_1, x_2, \ldots, x_n]$ from the units to which it is connected in the previous layer. Each signal is attached with an importance weight wj = [w1j,w2j, . . . , wnj] [GiFi09, p. 79].

The other models used in data mining are: **genetic algorithms** which are optimization techniques that use processes such as genetic combination, mutation, and natural selection in a design based on the concepts of natural evolution. Another worth mentioning is the **nearest neighbor method** which is a technique that classifies each record in a dataset based on a combination of the classes of the *k* record(s) most similar to it in a historical dataset (where *k* 1). Sometimes called the *k*-nearest neighbor technique. And the other technique is **rule induction** which is the extraction of useful if-then rules from data based on statistical significance and **data visualization** which is the visual interpretation of complex relationships in multidimensional data. Graphics tools are used to illustrate data relationships [SuSi06].

One of the most often used algorithms in data mining are **association rules**, a fundamental approach that is one of the oldest and most widely used techniques in data mining. It is used, for example, in supermarket basket analysis to identify relationships between purchased items [VoPo06]. Data mining methods, models and techniques are used in many branches. In practice data mining can be applied in a wide variety of areas disciplines such as: consumer's relationship management, banking, medicine and pharmaceutics, education, insurance, marketing, quality assurance management, logistics. For the purpose of current article the application of Data Mining models, methods and techniques will be presented in more details in a form of a review of foreign case studies in finance and telecommunication industry.

3. Financial Data Mining case study

The fundamental financial tasks for data mining are: forecasting stock market, currency exchange rate, bank bankruptcies, understanding and managing financial risk, trading futures, credit rating, loan management, bank customer profiling, money laundering analyses, stock market returns, foreign currency exchange rates and trading rules. Stock market forecasting includes uncovering market trends, planning investment strategies, identifying the best time to purchase the stocks and what stocks to purchase [KoVi05]. As S. Langdell claims "[…] data mining methods such as neural networks and decision trees can be a useful addition to the techniques available to the financial analyst and Data Mining techniques tend to require more historical data than the standard models". One of the most popular applications of Data Mining in Finance is DM of stock prices where exploratory data analysis is used. The largest challenge in mining financial data is to make sense of the text data

from different sources and to develop better models [KHYMK08, p. 571]. Specifics of data mining in finance are coming from the need to: forecast multi-dimensional time series with high level of noise; accommodate specific efficiency criteria (e.g. the maximum of trading profit) in addition to prediction accuracy; make coordinated multi-resolution forecast (minutes, days, weeks, months, and years); incorporate a stream of text signals as input data for forecasting models; ability to explain the forecast and the forecasting model [KoVi05].

In the case study conducted by Rob Gerritsen was presented assessing loan risks and how Data Mining helped the Rural Housing Service (project for US Department Agriculture) better understand and classify problem loans. The US Department of Agriculture (USDA) Rural Housing Service administers a loan program that lends or guarantees mortgage loans to people living in rural areas. This department administers 600000 loans and data concerning it are gathered in data warehouse. The USDA chose data mining to help it better understand these loans, improve the management of its lending and reduce incidence of problem loans. It uses data mining to find patterns which distinguish borrowers who repay quickly from those who do not. By usage of data mining techniques they had an ability to extract patterns and characteristics common in problem loans. At the USDA, the goal was to build a model predicting the loan classification based on information about the loan, borrower and property [Gerr99]. There was used for initial exploration Naive Bayes then decision trees and neural network models. The output variable that was used for the USDA loan classification model had five values: problem-less, substandard, loss, unclassified and not available and about 80 percent of loans fell into the problem-less category. After exploring the data with the Naive Bayes classification algorithm, they also trained a decision tree model which improved accuracy, generating a predictive accuracy of almost 85 percent. As Rob Gerritsen claims "Data Mining increases understanding by showing which factors most affect specific outcomes. For the USDA the initial model revealed that the important factors included loan type regular or construction, type of security such as first mortgage or junior mortgage, marital status and monthly payment size. The USDA's data mining study demonstrated the technology's potential as a predictor and learning tool" [Gerr99].

4. Telecommunication industry case study

Data mining in the telecommunication industry is a part of the support system for the decision-making process enabling many applications in this field. The most frequent ones are the following: telecommunication market analysis, preventing clients from shifting to other companies, sale of additional services to existing customer, assessment of the client's values and market segmentation.

In telecommunication companies, for the purpose of segmentation of the industrial market, the most frequently used variables include the location and the size of the revenue realized from the sale of telecommunication services [BSLD09].

The application of neural networks which is one of the main components of data mining was illustrated in a case study realized by Pinheiro, Evsukoff and Ebecken. It was based on Brasil Telecom Company. They showed the application of a cluster model to identify the insolvency behavior in mentioned Telecommunication company, where thanks to these clusters, the company can separate the customers into segments based on their characteristics and take different actions to increase revenue and avoid losses. As they have written "Based on knowledge about the customer, it is possible to monitor several groups of customers and perform distinct actions for each one. The second result is based on a set of predicting models to classify the insolvent customers. Using this model, the company can take preventing actions to avoid revenue leakage" [KMRe05]. A cluster model was based on an unsupervised learning, using Kohonen's self-organizing map which are widely used in unsupervised models, especially in identification of specific clusters. The Kohonen map was created by using techniques based on neural networks. Additionally, a multilayer perceptrons (MLP) neural network was used for predicting models. A distinct predicting model has been developed for each cluster identified by the first model, turning the input database more homogeneous, and increasing accuracy. The segmentation model of all Brasil Telecom clients helped in identifying the value of each client for the company and allowed for defining more efficient relationship actions. The ten groups of clients identified by authors of the case study can be segmented according to the value they aggregate to the company, allowing for creation of more specific products, more focused relationship actions and more objective billing and collecting activities management [KMRe05, p. 125-139].

The second example showed in a case study entitled "Data Mining-Based Segmentation for Targeting: A Telecommunications Example" by K. Maharaj, R. Ceurvorst emphasized the fact of the strong growth of data mining advances and applications of companies in dealing with complex problems. The authors claim that "[…] companies have become increasingly focused on the return on investment (ROI) for every endeavor and in order to boost ROI of product development and marketing initiatives, they must develop a more integrated understanding of consumer behavior, needs, attitudes and demographics and then leverage that understanding to target their initiatives more efficiently and profitably". It is all possible thanks to the application of Data Mining. The authors in their case study illustrated using a data mining process called Targeted Segmentation that can help companies in any industry to achieve integrated understanding of consumers. They showed it on the example of case

study from the Telecommunications industry, where a large service provider sought need- and benefit-driven segments that could be identified with at least 90% accuracy using only behavioral and demographic characteristics on their database. For purposes of comparison, they produced behavioral and attitudinal segmentations, in addition to the targeted segmentation. Targeted and behavioral segmentations yielded comparable degrees of differentiation, but only targeted segments were predicted well it is with better than 90% accuracy using the client data alone. Further, with targeted segments, 49% of the customers generated 70% of the company's profit. With behavioral segments, 43% of customers yielded only 58% of profit and with attitudinal segments, 40% of customers produced only 44% of profit. Compared to other than telecommunication industry targeted segmentation has produced similar types of results in numerous industries, including financial services, healthcare, automotive, fast-moving consumer goods, and others [KMRe05].

Conclusion

Data mining may help many enterprises from different industries improve key areas of its business activity. It can improve customer's service, help to prepare personalized offers for specified customers, it enables processing of different types of data, not only numerical ones. Thanks to the application of Data Mining methods, models and techniques enterprises can better compete on worldwide market, prepare better offers of products and services. The efficacy and benefits of selected Data Mining solutions' applications were showed in foreign case studies of financial and telecommunication industry.

Literature

[BSLD09] Bach M.P., Simicevic V., Leskovic D.: Data Mining in Telecommunications: Case Study of Cluster Analysis. Annals of DAAAM and Proceedings, Gale Group, Vienna 2009.

[Gerr99] Gerritsen R.: Assessing Loan Risks: A Data Mining Case Study. IT Pro IEEE, December 1999, available at: computer.org/itpro

[GiFi09] Giudici P., Figini S.: Applied Data Mining for Business and Industry. Second Edition, Wiley, West Sussex 2009.

[Giud03] Giudici P.: Applied Data Mining. Statistical Methods for Business and Industry. Wiley, West Sussex 2003.

[HaKa06] Han J., Kamber M.: Data Mining. Concepts and Techniques. Morgan Kaufman Publishing, San Francisco 2006.

[HaMS01] Hand D., Mannila H., Smyth P.: Principles of Data Mining. MIT Press, Cambridge, MA 2001.

[Kant03] Kantardzic M.: Data Mining Concepts, Models, Methods, and Algorithms. John Wiley & Sons, 2003.

[KHMK08] Kargupta H., Han J., Yu P.S., Motwani R., Kumar V.: Next Generation of Data Mining. CRC Press, New York 2008.

[KMRe05] Kitts B., Melli G., Rexer K.: Data Mining Case Studies. Proceedings of the First International Workshop on Data Mining Case Studies, Elder Research 2005.

[KoVi05] Kovalerchuk B., Vityaev E.: Data Mining for Financial applications. http://www.math.nsc.ru/AP/ScientificDiscovery/PDF/data_mining_for_financial_applications.pdf

[Laro05] Larose D.: Discovering Knowledge in Data. An Introduction to Data Mining. John Wiley & Sons, New Jersey 2005.

[LXWL08] Lin T.Y, Xie Y., Wasilewska A., Liau Ch.: Data Mining: Foundations and Practice. Springer, Berlin 2008.

[PEEb05] Pinheiro C.A., Evsukoff A.G, Ebecken N.: Neural Network to Identify and Prevent Bad Debt in Telephone Companies. In: Data Mining Case Studies. Proceedings of the First International Workshop on Data Mining Case Studies held at the 2005 IEEE International Conference on Data Mining. Eds. B. Kitts, G. Melli, K. Rexer. Elder Research, Houston 2005.

[PTMa08] Poncelet P., Teisseire M., Massegia F.: Data Mining Patterns. New Methods and Applications. Information Science Reference, New York 2008.

[Pyle99] Pyle D.: Data Preparation for Data Mining. Morgan Kaufman Publishers, San Francisco 1999.

[SuSi06] Sumathi S., Sivanandam S.N.: Introduction to Data Mining and Its Applications. Studies in Computational Intelligence, Volume 29, Springer, Berlin 2006.

[TALS07] Turban E., Aronson J.E., Liang T., Sharda R.: Decision Support and Business Intelligence Systems. Prentice Hall, New Jersey 2007.

[TSAK08] Turban E., Aronson J.E., King D., Sharda R.: Business Intelligence. A Managerial Approach. Prentice Hall, New Jersey 2008.

[VoPo06] Voges K.E., Pope N.: Business Applications and Computational Intelligence. Idea Group Publishing, London 2006.

[Zior10] Ziora L.: The Role of Business Intelligence Systems in the Decision Making Processes in International Enterprises. Phd dissertation, Wrocław University of Economics, Wrocław 2010.

Streszczenie

W artykule przedstawiono dyskusję metod eksploracji danych, modeli i technik, dzięki którym przedsiębiorstwa mogą lepiej konkurować na światowym rynku, lepiej przygotować oferty produktów i usług. Skuteczność i korzyści wynikające z zastosowania wybranych rozwiązań Data Mining przedstawiono na podstawie studium zagranicznych przypadków z sektora finansowego i telekomunikacyjnego.

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IT SOLUTIONS FOR THE CUSTOMER CONTACT CENTER

Introduction

The quality of a company-customer interaction is often a key factor deciding about the client's loyalty. Customers claim that the awareness of an insufficient service level is determined by what follows [www2]:

- waiting very long for service response,
- getting stuck during automated self-service,
- inconvenience of describing a problem repeatedly,
- inability of the consultant to answer a customer inquiry properly.

An insufficient customer service level has direct negative effects as it results in a decrease in enterprise revenue. The consequences involve churning costs, when customers resign from a company's service and turn to a competitive company because of bad experiences. Research shows that the value of every single lost customer is an estimate of about 243 USD yearly [www4].

Clients expect their problems to be solved during the first contact with helpdesk or the customer service department. According to experts, solving problems during a first contact on the level of 80-95% is a very good result [www7]. In order to achieve such results, however, a company needs to have an experienced staff and advanced IT technology. The aim of this article is to present modern IT solutions used in the process of communication between a customer and a company.

Generation Y communication needs

Over the last years, traditional communication channels such as a phone or a fax, have been gradually giving place to on-line communication. The constant growth in the number of blogs, subcasts, chats, community-portals and other interactive communication forms modifies relationship between a company and a customer. It results from a generational differences of people who entered consumer market in the first years of 21st century (the population of a demographic boom of the eighties).

Customers born between 1982 and 2001 are called Millenium Generation or Generation Y. They grew up in the time of the Internet and perceive it as a part of their own life. They see the Internet as a place of social interaction, shopping, working, making friends and sharing their problems. Generation Y representatives prefer on-line communication forms – chats, video conversations, blogs. It also has a big impact on the way of making a purchase decision. The factors that Generation Y consider most important while making a purchase decision are convenience (71%) and style (69%), rather than price (29%) and guarantee (14%) [www5]. This is shown in a survey conducted by The Economist Intelligence Unit and Genesys IT company.

The priority for the new generation is high quality of service. What the customers value most is an individual approach and the access to products and services at any time. The final purchase decision also depends largely on opinions of peers. Traditional marketing communication and a company's advantages such as market position and brand name, are not as important for the new generation as the opinion coming from a social network. Also B2C activities are getting less efficient. Nowadays the most effective communication channels for Generation Y are the Internet communities (41%), enlarging the content of on-line services (40%) as well as peer recommendations (34%) [www5].

It is likely that in the near future Generation Y representatives will become even more demanding. The only way for enterprises to meet customers needs will be implementing new technologies, such as video conversations or enhanced IVR systems with voice recognition modules. The extended video presentation will allow customers to watch maps, tariff plans, products, account balance and other useful information on screen.

Integrated communication with customer

As customers start using new communication channels, enterprises have to adjust their customer contact strategies accordingly. The most common problem here is to change the nature of customer service so as to use multiple, integrated channels of communication instead of single ones.

The integrated communication occurs when a client asks a question or communicates a problem via one communication channel, but turns to other communication channels for further problem solving. The survey conducted by Ovum requested by Alcatel-Lucent proves that over 93% of Polish customers take advantage of various communication channels. Integrated communication solutions are used by customers of all age groups – not only young people with high technical skills [www3].

The way a customer behaves in the process of communicating with a company is the following: 54% of clients begin by making an inquiry via Internet and later proceed to talk with agent-assisted service. Nearly three-quarters of clients consider a phone conversation as the most helpful communication channel, however, 37% of them demand more improvement in this area [www3]. Customers tend to start communication through a channel that is most suitable for them, but in case they come across a serious problem or an obstacle, they turn to a skilled representative to come up with a solution to their inquiry.

Contemporary Contact Center is not only the telephone exchange with phones and connection queue management software. It comprises advanced solutions integrating telephony with existing catalog services, management, audit and call recording systems. IP technology embraces it all and is capable of integrating with many different systems, i.e., [Marc11]:

1. It is possible to create automatically a telephone book based on records in catalog services such as Active Directory or LDAP, so that phone users can access constantly updated information.
2. There is a possibility to connect an agent software to the enterprise application, provided that integrators work out parameters transmission from the agent software to the external application. In case of web application, a customer ID (e.g., phone number) can be inserted in URL character sequence.
3. It is possible to identify a customer basing on inquiries to the external data base, for example CRM system or any other application capable of a connection by means of the standard API.

While designing hi-tech CC, a company should consider the necessity to record all or only selected calls. Apart from direct connections also conference connections should be recorded. The tasks mentioned above are not easy to carry out, especially when the calls are ciphered. The stream record itself does not end the task. The system also needs to have a functionality of a record search. The query is usually performed basing on a destination number, but in some special cases additional parameters are required (date, agent). Moreover, it must be possible to browse through recordings of a particular agent. Additionally to the recordings, statistical information describing the parameters of the work of the system is necessary. Therefore, patterns for available reports must be defined. The patterns, besides, should be easily modified and developed in accordance with the demands of the manager or CC administrator.

Interactive IVR menu makes it possible to manage external connections basing on customer needs, to make self-service accessible and to obtain information from the caller. In reality, however, especially in administration, interactive menu is often replaced by other features. Many examples can be presented here [Kosi10]. Many municipal offices have TeleIT Departments with the function of a city CC. For example when an inquirer calls Poznań Municipal Office he will be welcomed with a standard announcement and later connected with a clerk. This solution enables solving a problem or gaining information fast, without the necessity to listen to the whole IVR command lines. In the Human Resources Development Center (HRDC), a unit of the Ministry of Labor and Social Policy, Green Line project was implemented. It is addressed to persons and economic entities who are customers of public employment services or have demands that fit the competence of HRDC. The solution lightens Labour Office clerks load. The knowledge base contains the unemployed profiles, job postings, training courses, labour market knowledge, but most importantly, as the primary work tool at informative positions, it integrates many different systems of a municipal office. The Polish Statistical Office (GUS) uses CATI* method for its researches (e.g., Agricultural Census 2010, National Census 2011), which is an interactive computer system that helps interviewers to ask questions over the telephone, using a data entry interface and reporting system. In the Public Transport Authority in Warsaw, a voice portal was implemented. It contains IVR system integrated with speech recognition and syn-

* Computer Assisted Telephone Interviewing (CATI) is an interactive front-end computer system that aids interviewers to ask questions over the telephone. The answers are then keyed into the computer system immediately by the interviewer. The computer assists by automatically controlling questionnaire branching, conducting on-line editing for reconciliation directly with respondent, scheduling future calls and capturing a variety of management information about the interview. The application of CATI is usually considered to address timeliness and other quality problems.

thesis, allowing for getting information about timetables, travel planners from specific stations through simple man-machine dialog. Thirty percent of calls are fully automated. The system shortens the time of gaining information to only 90 seconds, because conversation with an assistant is not necessary.

One of the most important tasks of CC is routing and transmitting a large variety of requests received through different channels of communication, basing on conditions such as time, connection priority, agents availability and their skills, or business criteria taken from the customer information base. The criteria allow for external connections queing as well as routing the requests to the most suitable and well-prepared agents. This technique is called a conditional routing. To manage connections, the following information is used: incoming or outcoming number, date and time of connection, queue load and waiting time, data downloaded from the database on the basis of IVR and DTMF codes, customer information or language. Another criterion may be an agent ID identified as the last to serve a customer. Conditional routing makes it possible to route connections, basing on agents' individual abilities such as language skills or specific knowledge (e.g., company offer). Furthermore, it is easy to line a customer to a particular agent.

An example of a successful CC implementation is IT HelpDesk for Allegro Group. The system was suited to support nearly 50 agents, with the capability to extend. The solution comprised not only standard CC components, such as connection queue (IVR) or agent application, but also rare functionality of encrypted calls recording at the area of CC [Marc11].

Modern IT solutions for Contact Center

Genesys 8 enables CC agents to have a simple, coordinated customer conversation across multi-channels and contact points. With the support of an integrated conversation and context manager, it is possible to improve customer service level by synchronizing conversations across multiple customer touch points including in-person, Contact Centers, Web, mobile devices and social media. Enterprises can orchestrate conversations enabling various service representatives to understand the context of the issue regardless of the channel of communication. The software, basing on implemented feature of Context Services, allows for a complex insight into a customer service process by weaving together the frequently disconnected threads that hamper multiple departments and communication channels [www1].

The basis of Genesys 8 software is an integrated platform, interface, and development environment that offers the following benefits:

- improved customer experience through an integrated conversation and context manager that synchronizes conversations over time and across channels, contact centers, Web, mobile and social media,
- role-based interfaces that enable each enterprise user to design the customer experience, configure the software, engage with customers and optimize the customer service operation, depending on their role,
- flexibility through modular solutions for specific needs.

Modular solutions of Genesys 8 platform are:

- Genesys Contact Center, dedicated to traditional contact service agents, joining Genesys platform and tailored role-based interfaces and specialized tools,
- Genesys iCFD (*intelligent Customer Front Door*), the solution which uses the Conversation Manager with its embedded Context Services to collect customer intentions and needs, determine how to treat them, and direct customers to the best resource,
- Genesys eServices, a tool that brings together WWW channels, mobile and social channels to support the contact center, marketing, online-sales, and Web and back office agent organizations,
- Genesys Workforce Optimization, enabling companies to maximize efficiency through recording calls, speech analysis and quality management, workforce management, skills and training,
- Genesys Performance Management, including complete reporting and analysis, using the Advisor family and Interactive Insights applications for insight across all channels,
- Genesys iWD (intelligent Workload Distribution), allowing for creating business processes and rules for routing tasks and work items to the most appropriate resource.

Inteligent Workload Distribution (iWD)

Modern CC is perceived as a complex customer service system, integrating contacts maintained by CC with other communication channels, e.g., direct contacts managed by customer service points, trade and support departments. Such an integration of activities performed by various company--customer touch-points, necessitates the use of effective business applications. In a stand-alone business application, the key business processes (*customer and*

sales service) are dynamically mapped and managed by best prepared resources that a company possesses. The key factor becomes the resource optimization through fully integrated back and front office. All those features are ensured by intelligent Workload Distribution (iWD) system [iWD11].

iWD system is an element of a customer service strategy throughout all contact channels. It allows for dynamic prioritizing and distributing tasks among all employees, by means of consolidating IT systems that an enterprise uses (such as ERP, BPM or other tailored applications) into one list of tasks sorted according to business values. iWD ensures that regardless of the place and communication medium, each resource will proactively be provided with the most crucial and valuable tasks in terms of enterprise revenues.

iWD system goes beyond the standard CC area and integrates the whole company, i.e., outlets, distributed employees, back-office experts and all communication channels (fax, phone, letter, e-mail, web form). The tasks are automatically distributed among workers according to their capacity. The status of tasks is monitored and all possible threats and processes requiring optimazation are quickly detected.

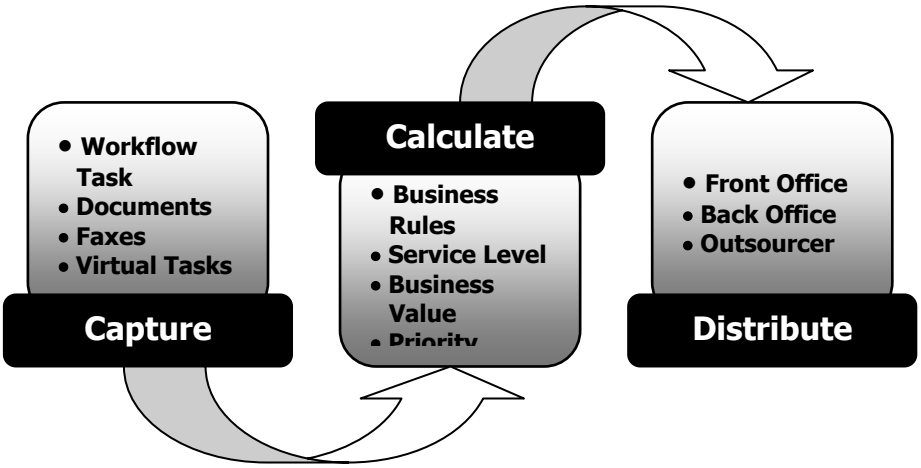

Figure 1. Intelligent Workload Distribution

Source: [iWD11].

Figure 1 presents iWD system functionality. It consists of the following processes:

- capture – gathering information about tasks,
- calculate – business value rating, tasks implementation prioritizing and time-limits assignment,
- distribute – tasks allocation to best prepared consultants.

The main goal of iWD implementation in an enterprise is optimizing the resource management, meaning undertaking tasks according to business priorities, selection of the most suitable resources to do specific jobs, and supporting the declared service level. The system ensures not only real time tasks distribution and allocation but also monitors the status of issues, which means higher resource productivity and more flexible management. The final effect of using iWD system is an increase in customer service level and consequently improving a client satisfaction.

Worldwide iWD solutions are found in enterprises from financial (UniCredit Group, Bank DnB NORD, AMB Generali) and telecom (Deutche Telekom, Telecom Italia, Bouygues Telecom) sectors, public units (Public Works and Government services Canada, Australian Taxation Office) and various branches of industry. Also in Poland, two big enterprises are implementing iWD system.

Summary

Present-day customers expect their business partners to interact through increasing number of channels, e.g., SMS, e-mail, live chats, Self-service web portals, social networks. In terms of contacts with a company, factors which customers value most are: the convenience of using multichannel communication, an individual approach, and finally, high-skilled, competent, initiative staff.

Nowadays, a company has to look for a computer system which would not only support the communication with a customer through any channel, but would also take care of all processes taking place inside a company, the processes that initiate the client-company interaction. Their quality and reali¬zation time influence directly the final customer care. It means that imp¬lementing CC system involves deep changes for all the company and its processes, not only changes in terms of a customer care department. A lot of companies using CC systems for a long time, decide to replace them, and only essential improvements have been implemented so far. There are new tools on the IT market which allow for greater benefits from the cooperation with a customer/inquirer.

Literature

[iWD11] iWD – efektywna, kompleksowa obsługa klienta, czyli jak wykorzystać potencjał firmy, którego nie znamy. "Computerworld" 2011, nr 8.

[Kosi10] Kosieliński S.: Dzwonię w bardzo typowej sprawie. "Computerworld" 2010, nr 18-19.

[Marc11] Marciniak M.: Współpraca w centrum uwagi. "Computerworld" 2011, nr 5.

[PoWi03] Potocki A., Winkler R., Żbikowska A.: Techniki komunikacji w organizacjach gospodarczych. Difin, Warszawa 2003.

[www1] Alcatel Lucent udostępnia nowy pakiet oprogramowania. http://www.technika24.pl/alcatel-lucent-udostepnia-nowy-pakiet-oprogramowania-genesys-8/ (April 2011).

[www2] Ekonomiczne konsekwencje jakości obsługi klienta w Polsce. http://www.epr.pl/ekonomiczne-konsekwencje-jakosci-obslugi-klienta-w-polsce,raporty,23419,1.html (May 2011).

[www3] Komunikacja przez różne media – doświadczenia klientów. http://www.alcatel-lucent.com/wps/PA_1_A_1OB/images/pl/Images/Large_Callouts/PL_Komunikacja_przez_rozne_media.pdf (April 2011).

[www4] Niska jakość obsługi klienta powoduje straty w wysokości 338,5 mld USD rocznie. http://marketing.org.pl/index.php /go=2/act=4/did= 1106/aid=m4b30da2a2685f (May 2011).

[www5] Początek rewolucji Y w obsłudze klienta. http://www.marketing-news.pl/theme.php?art=879 (May 2011).

[www6] Tradycyjne czy nowoczesne kanały komunikacji? http://www .logistykafirm.com/transport_art.php?did=1&aid=7212&p=&cat=1&catname= (May 2011).

[www7] WFM – sposób na skuteczny contact center. http://www.crm.pl /pokaz.php?kategoria=1&id=213 (April 2011).

Streszczenie

Celem artykułu jest zaprezentowanie nowoczesnych rozwiązań informatycznych wykorzystywanych w procesie komunikacji pomiędzy klientem a firmą. Wykazano, że w dzisiejszych czasach firma musi szukać systemu komputerowego, który nie tylko obsługuje komunikację z klientem poprzez dowolny kanał, ale także dba o wszystkie procesy zachodzące wewnątrz firmy, inicjujące interakcję klient-firma.

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EVIDENCE-BASED PRACTICE IN INFORMATION TECHNOLOGY PROJECT MANAGEMENT

Introduction

The term evidence-based (EB) practice has been first developed in medical science. However, now this approach has received a strong position in social sciences. The hypothesis in the paper states that instead of blindly copying the opinions and behaviours of others, the development of a culture of evidence-based actions in business organizations is not only useful, but also necessary.

Evidence-Based Approach

Supporters of evidence-based practice have claimed that the approach results in the best practices and the best use of resources. The opponents have claimed that evidence-based practice is overly simplistic and constraints professional autonomy. Proponents add that evidence-based practice is developed because otherwise the professionals rely on a range of less reliable indicators i.e., knowledge gaining during primary trainings, prejudice and opinions, outcomes of previous cases, fashions, advices of senior and not so senior colleagues, observations done in other countries or in other social environments.

Evidence-based (EB) policy has been defined as an approach supporting people making well-informed decisions about policies, programmes and projects by delivering the evidence from research. In contrast to that there is an opinion-based policy, which is based rather on selective use of evidence or on the views of individuals or groups [Davi04]. In evidence-based approach evidence should be systematically searched, critically appraised and rigorously analysed according to explicit and transparent criteria. EB practice requires a more rigorous science applications systematically realized by the practitioners. The EB practice should provide a methodology and a set of processes to

produce an incrementally developed knowledge. EB practice is based on the assumption that the truth will out and that it is possible to provide independent and objective evidence to evaluate activities' options [TrRe00].

The major challenge of EB practice is to find ways of making evidence from systematic research available to practitioners along with the skills and support required to make judgements about its validity and usefulness. Evidence orientation is to provide answers how good is the evidence for the apparent problem. A common misunderstanding of evidence-based practice is the consideration and the acting only on the basis of good evidence. However, in some situations it may be the case that the best external evidence is of poor quality, but even then it is somehow helpful to clarify the problem. EB practice is not oriented towards rejection of models and framework or opinions of champions and gurus. The approach encourages considering the local system of values, to constantly verify the knowledge and continuously penetrate knowledge resources. EB practice suggests adapting an attitude of wisdom. Wisdom means acting with knowledge while constantly doubting what you know [ScVe07]. It entails striking a balance between arrogance (assuming you know more than you do) and uncertainty (believing that you know too little to act). With the attitude of wisdom, managers (and decision makers) can do things and still keep learning simultaneously.

In EB approach, researchers operate by sharing all of their technical skills with those being researched. The result is that such research imposes neither hypotheses nor solutions, all findings are grounded in mutually agreed forms of practice [TrRe00]. Generally, evidence is the available fact or information indicating whether a belief is true or valid. Evidence is facts that support people to justify their opinions or explain their attitude, proposed solutions and questions. The bottom-up hierarchy of evidence includes as follows: systematic reviews and meta analyses, randomized controlled trials, quasi-experimental studies, case control studies, before and after comparisons, cross-sectional, random sample studies, process evaluation, formative studies and action research, qualitative case study and ethnographic research, descriptive guides and examples of good practice, professional and expert opinions. The qualitative research methods that allow for evidence gathering are following [DAYJ04]:

- narrative summary, which covers narrative description and ordering the primary evidences,
- thematic analyses, that include identifications of major, current themes in literature, summary of findings in primary studies under the thematic headings,
- grounded theory, which is a constant comparative method for identification of patterns and interrelations in primary data,

- meta-ethnography, that includes reciprocal translational analysis which identifies key theme in each study, then seeks to translate these into the context of another study,
- meta-study that is a general framework including question formulation and selection of primary studies, divided into meta-theory, meta-data and meta--method,
- content analysis, where evidences from each primary study are coded, extracted with tools designed to aid reproductability,
- case survey, covering studying the findings and attributes extracted from each primary case study,
- qualitative comparative analysis, which covers all necessary and sufficient conditions for particular outcomes to be observed.

Evaluating the evidences involves six basic criteria [RMDe08]. The first requirement of evidence is construct validity. The test of cause-effect relationship must establish the construct validity of both the presumptive cause and effect. Second, the internal validity is the extent to which a study properly demonstrates a causal relationship between a presumed cause and effect. The third criterion, effect size is a measure of the strength of the relationship observed between two variables. Fourth, generalizability or external validity refers to the extent to which a result holds across populations, settings, procedures and times. Fifth, intervention compliance refers to the occurrence of all conditions required to induce a particular cause or apply a specific treatment. Sixth, contextualization is empirical evidence regarding how context influences the phenomenon under study. EB practice opponents argue that in the qualitative research approach the generalization is difficult, therefore what is needed is a combination of EB work and critical analysis based on a theory. In social sciences, for the verification of the arguments, researchers ask for authorities who say that, mathematicians demonstrate and demands mathematical proofs, but information technology (IT) professionals require an IT solution implementation. In management science, managers frequently base their business decision on benchmarks, hopes, fear, observations, what others are doing and what they have done in the past. To make decisions based on evidence, managers must get the evidence in the first place, so they have to learn how to do their own research. In other cases, they can consult existing evidence, evaluate and apply it according to sound standards. Anyway, they constantly should confront facts with general opinions.

Evidence-Based Approach for IT project

Evidence-based practice is a strategic as well as an operational activity and part of its role is to build an evidence base for future generations of managers and IT professionals. Evidence-based practice should be the first line of response to unanticipated events in the sense of identifying what is already known about the project and what is not. Factors important as evidence are as follows: experiences, expertises and judgements, financial resources, values of lobbyists, pressure groups, stakeholders and consultants, habits and traditions, pragmatics and contingencies [Davi04].

The main problem for EB management is the uncertainty of social knowledge. Every project has its risks and opportunities, certainties and uncertainties, and therefore every project has to balance planning and changing. However, balancing is required because projects also run the gamut from production-style ones in which uncertainty is low, to exploration-style ones in which uncertainty is high [High04]. There are two types of project uncertainty that are discussed by Chin [Chin04]. Internal uncertainty involves those project dimensions that can be more or less controlled by the project manager, including technical obstacles, scope, schedule, cost, communication, trade-offs. External uncertainty involves those factors which are not under the project control, such as the industry's business environment, changing customer requirements, the competition and business strategy decisions, changes in the industry-specific business environment. Generally, the more mature a project organization, the less internal uncertainty it will have in its projects. Experienced organizations have learned through trials and errors and thus, they are less likely to repeat mistakes in project management. Nevertheless, there are areas external to the actual project that have the great influence on its outcomes. Project managers who successfully work in an agile environment will turn much of their attention away from the project itself and toward the external influences. They cannot control real external forces, but, if agile enough, they can make the appropriate adjustments to keep the project objectives in sight. By scanning the environment outside of the project itself, the project manager can identify business opportunities that, when combined with the technological opportunities will help increase the project effects. In classic project management, the project manager usually monitors variance to the internal elements of schedule, scope, and cost to judge project success. However, in an agile project, project managers want to facilitate the correct course changes necessary for project success. By monitoring the trends in external business environments, the project managers are able to make the best decisions that will keep the project aligned with the true needs of users.

Evidence-Based Approach for agile method development

Agile methods are strongly based on evidence orientation. The Agile Manifesto principles define the necessity to deliver the working software frequently as the evidence and the primary measure of work progress [FoHi01]. Initiating and sustaining an effective agile development program is a challenge. First, the implementation should involve far more that the project team. A broad array of cross-functional impacts should be considered. Second, the technical practices that agile methods bring i.e., short iterations, incremental development, test-first development, continuous integration – are obligatory. Finally, although agile approach would help if the company has changing requirements, the plans' construction is important to ensure customer satisfaction and timely product delivery. Incremental design and test-driven development mean that programmers work in small steps, providing effects before moving to the next. This takes place in three parts: start by creating the simplest design that could possibly work, incrementally add to it as the needs of the software evolve, and continuously improve the design by reflecting on its strengths and weaknesses. Iterative development in the agile methods is an approach to building software (or anything) in which the overall lifecycle is composed of several iterations. Each iteration is a self-contained composition of the three mentioned above parts. The goal for the end of iteration is an iteration release, a stable, integrated and tested partially completed system as an evidence of work. EB practice means treating the business organization as an unfinished prototype – running experiments and learning all the time [ScVe07]. In iterative and incremental IT development, the EB management demands from the project team time for reflection and encourages after-event reviews. This is a disciplined way of looking at what is going right or wrong. Lots of people claim they have no time for iterations, so they repeat the same mistakes. In the process of developing and testing theory, the systematic accumulation of empirical observations constitutes the evidence for judging the theory's merits.

Evidence-based practice is a general approach towards strategy of project to ensure its sustainability and agility, as well as effectiveness and social acceptance. Evidence is the essence of human knowledge [RMDe08]. Scientific evidence is knowledge derived through controlled test and observation. Evidence-based practice is the complimentary use of scientific evidence and local business practices. IT project pilot studies and case studies are the source of evidence [Davi04]. However, evidence that is selective and not subject to careful critical appraisal and risk assessment, can often lead to inappropriate course of action. Therefore, the effective delivery and implementation of evidence require high quality qualitative data using in-depth interviews, focus groups, consultative methods (such as Delphi method), observational methods,

user-observation methods and co-worker surveys. Economic evidence uses economic appraisal and evaluation methods, including econometric analysis and modelling.

Evidence-based practice encourages to experiential learning, which covers concrete experience, observation and reflection, formation of concepts and abstract generalizations, testing concepts in new situations [Kell08]. The term learning-by-doing team is an accurate description of an effective project management team. Such team needs to learn collectively to create a software application. Therefore the IT project management is a process of knowledge development and acquisition. Knowledge is a curious construct that exhibits many facets and is difficult to define. Geisler argues that knowledge is a mental or cognitive state or phenomenon in which an individual has mastered a description of reality, a concept [Geis07]. Knowledge is stored in the individual brain or encoded in organizational processes, documents, project products, services, facilities and information systems. Key function of a modern project management office is to be the focal point for corporate knowledge management or at least of knowledge management with respect to project management. Knowledge management is a process that helps organizations identify, select, organize, and transfer important knowledge and expertise that are part of the organization's memory. The question of how to elicit tacit knowledge from expert employees has become increasingly important. EB practice has rapidly developed in this gap to produce a professional-defined and led strategy that promises effectiveness of IT project management. Some managers believe that if a certain innovation developed in one country can be easily transferred to another one, the same is with the management methods. Therefore there is a necessity to persuade people that they are able to develop their own approaches basing on local facts, although it is perhaps more expensive and more risky. There is nothing wrong with learning from the experiences of others – it is a lot cheaper and easier to learn from their mistakes and successes than to treat every project challenge as strictly speaking terra incognita. That is why benchmarking, using others' performance and experience makes a lot of sense.

The focus on effectiveness is the central driving force of evidence-based practice. EB practice demands convincing arguments that IT project effects are achievable. The focus on proceduralization and the types of procedures involved in evidence-based practice mirrors many of the project management methods introduced over the last two decades. Procedures should now be introduced to demonstrate how the project value justification process is executed using the major standard deliverables (what), process flow (how) and checklist or measurement criteria (why) templates. The deliverables, process flow and checklist templates are based on real-world practical implementation and will serve as excellent references for further practices. Project value justification process covers determining business value i.e., organizational, cultural and value analysis, determining strategic business alignment and competitive align-

ment value analysis [Bain04]. Aside from revenues and cost savings, sources of value for IT project organization include competitive differentiation, brand development, enhanced customer loyalty, satisfying legal requirements, original research. Producing the IT project value assessment is based on production of integrated business and technology values and risk assessment scores. The purpose of the process is to obtain the commitments or no commitments from executives and senior management for project funding and realization. These issues are usually considered in feasibility study which should focus on whether a particular project is doable and worth doing.

Conclusion

Evidence-based practice creates opportunities to support the development of agile project organization which must be able to detect changing markets, rapidly learn, detect new technologies, and adapt them to the organizational culture. Models of IT project development for sustainability must recognize the overburdened state and the consequent need to take advantage of existing social institutions, structures and management methods that promote sustainability. Some people argue that facts speak for themselves and only for themselves; however lack of theories in management science encourages following good practices and considering evidences as the premises for IT project decision making. There is only a strong request to verify them, constantly re-evaluate, reconsider and monitor.

Literature

[Bain04] Bainey K.R.: Integrated IT Project Management. A Model-Centric Approach. Artech House, Boston 2004.

[Chin04] Chin G.: Agile Project Management. How to Succeed in the Face of Changing Project Requirements. Amacom, New York 2004.

[Davi04] Davies P.: Is Evidence-Based Government Possible? 4th Annual Campbell Collaboration Colloquium, Washington D.C. 2004, http://www.nationalschool.gov.uk/ policyhub/downloads/JerryLeeLecture1202041.pdf (Accessed January 2010).

[DAYJ04] Dixon-Woods M., Agarwal S., Young B., Jones D., Sutton A.: Integrative Approaches to Qualitative and Quantitative Evidence. Health Development Agency, London 2004, http://www.nice.org.uk/nice Media/ pdf/Integrative_approaches_evidence.pdf (Accessed January 2010).

[FoHi01] Fowler M., Highsmith J.: The Agile Manifesto. http://andrey. hristov.com/fht-stuttgart/The_Agile_Manifesto_SDMagazine.pdf (2001).

[Geis07] Geisler E.: Knowledge, Information, and Knowledge Systems: Explaining the Conceptual Confusion. In: Knowledge-Based Enterprise. Theories and Fundamentals. Eds. N. Wickramasinghe, D. von Lubitz. Idea Group Publishing, Hershey 2007.

[High04] Highsmith J.: Agile Project Management: Creating Innovative Products. Addison Wesley, Boston 2004.

[Kell08] Kelly A.: Changing Software Development: Learning to be Agile. John Wiley and Sons, Ltd, Chichester 2008.

[RMDe08] Rousseau D.M., Manning J., Denyer D.: Evidence in Management and Organizational Science: Assembling the Field's Full Weight of Scientific Knowledge Through Syntheses, 2008, http://www.evidence-based-management.com/ research_practice/articles/ evidence_draft _annals_of_ aom_jan08.pdf (Accessed January 2010).

[ScVe07] Scott S.V., Venters W.: The Practice of e-Science and e-Social Science, Method, Theory and Matter. In: Virtuality and Virtualization. Eds. K. Crowston, S. Sieber, E. Wynn. Springer, NY 2007.

[TrRe00] Trinder L., Reynolds S.: Evidence-based Practice: A Critical Appraisal. John Wiley and Sons, Chichester 2000.

Streszczenie

W opracowaniu przedstawiono podstawy podejścia zarządzania i praktyki gospodarowania silnie zorientowane na wykorzystanie empirycznych dowodów. Zdaniem Autora, praktyki te są porównywalne do metodyk lekkich zarządzania projektami informatycznymi. Wykazano ponadto, że praktyki te wspomagają rozwój zrównoważony projektu, oparty na rejestracji faktów i badaniach jakościowych.

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DATA COLLECTION THROUGH WEB HARVESTING FOR REAL ESTATE MARKET RESEARCH

Web harvesting as an important data collection tool for further research

A research study requires that the researcher have the data and their analysis in order to confirm or refute a hypothesis. Data can be gathered in many ways, including primary and secondary sources. Considering waste amounts of data stored in various WWW services, one of the developing and promising method for data collection is through web harvesting.

The development of information technology means that it is possible to get aggregated data more easily and faster than ever before. The Internet as a world-wide network is a huge repository of various data as yet in unaggregated format. An example of such data which change dynamically are advertisements, selected at defined time intervals which can be used to track or forecast changes. Such information may be available in an aggregated format at a later date from a monthly, quarterly perspective, semi-annual or annual. This is why the only step in this case is to use the techniques for automatic selection and download of data from any portal which is of interest.

"Web harvesting is commonly used to describe Web scraping from a multitude of sites. It also refers to an implementation of a Web crawler that uses human expertise or machine guidance to direct the crawler to URLs which compose a specialized collection or set of knowledge. Web harvesting can be thought of as focused or directed Web crawling" [WWW1].

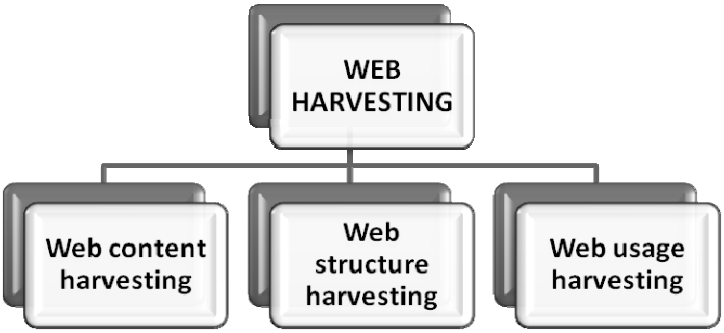
There are three methods used in Web Harvesting [WWW2]:

1. Web content harvesting – is concerned directly with the specific content of documents or their descriptions, such as HTML files, images or e-mail messages. Since most text documents are relatively unstructured (at least

as far as machine interpretation is concerned), one common approach is to exploit what's already known about the general structure of documents and map this to some data model. Another approach to Web content harvesting involves trying to improve on the content searches that tools like search engines perform. This type of content harvesting goes beyond keyword extraction and the production of simple statistics relating to words and phrases in documents.

2. Web structure harvesting – takes advantage of the fact that Web pages can reveal more information than just their obvious content. Links from other sources that point to a particular Web page indicate the popularity of that page, while links within a Web page that point to other resources may indicate the richness or variety of topics covered in that page. This is like analyzing bibliographical citations – a paper that's often cited in bibliographies and other papers is usually considered to be important.
3. Web usage harvesting – uses data recorded by Web servers about user interactions to help understand user behavior and evaluate the effectiveness of the Web structure.
   - General access-pattern tracking analyzes Web logs to understand access patterns and trends in order to identify structural issues and resource groupings.
   - Customized usage tracking analyzes individual trends so that Web sites can be personalized to specific users. Over time, based on access patterns, a site can be dynamically customized for a user in terms of the information displayed, the depth of the site structure and the format of the resources presented.

In order to get data for research studies, WWW page contents must be reviewed which is why the best choice will be use of the Web content harvesting method. In analyzing the contents of Web pages we must focus on the type of data. On Web pages there exist various types of data such as that which is alphanumeric, fixed images, and dynamic elements such as animation presented in technologies such as Adobe Flash or Microsoft Silverlight. The data which can be retrieved the most quickly and without further analysis are the alphanumeric data. There's also a way to get the data from images however the process is more time-consuming and requires the use of an additional technique called Optical Character Recognition. Due to its design there currently isn't an effective way to get data from animated elements on Flash or Silverlight from the internet.



Graphic 1. Methods of 'WebHarvesting'

Architecture of a system for retrieving information from the Internet

For the program to retrieve information in accordance with our parameters, it must be properly designed and the algorithm has to correctly manage the ability to multi-thread and communication with the database.

The process of retrieving data from a portal may turn out to be time--consuming due to the number of Web pages which the program must access. A well-written program with the appropriate ability to multithread and with multi-core functionality will significantly shorten the data retrieval time and will make full use of the power of today's computers. Another important element of the program is the definition of the number of connections which the specific instances can make with the Web server where the retrieved data is located. By analysis we can experimentally determine this number. A quantity that is too high will overload the Internet connection and the server from which the data is being retrieved, which in an extreme case could result in an accusation of a Denial-of-service attack or it could crash the web site system. Analysis has shown that an increase in the number of connections results in increased capacity to a certain point, after which further increases do not bring any reduction in the total time needed to retrieve data. The final element in the design is the selection of databases in which to store the retrieved data. Selection here should be based on the number of records to be stored and their later preliminary analysis. Selection of the databases facilitates statistical analysis and calculations, as well as simple operations at an intermediate level of complexity such as determining the median. Such methods will make it easier later on, for example to further analyze millions of records in a statistical software.

During data retrieval and once it is stored, verification must be performed in order to cull the data which has been improperly selected due to any errors in the parameters. The next challenge may be data which has been erroneously input by someone for example in an advertisement on a portal. In this case criteria must be determined for weeding out this data.

A good example of the data aggregation method in use is the 'e-Barometer of Real Estate Ads' done by the Institute of Economics at the University of Information Technology and Management in Rzeszow. The Barometer collects data in an automated manner in monthly period on the real estate market such as prices, size, market type, number of rooms, location by province, city, and street, together with GPS data.

The program was written in C# while the data are stored in a PostgreSQL database. The main algorithm was designed in such a way that on the one hand it takes full advantage of the computer's resources while on the other hand it assures a scalability for new real estate portals. This is done through the application of modular construction. The core is a module which is responsible for communication with the database. Another module facilitates data retrieval from a Web page with the use of appropriate filters. For each portal a module with filters was created.

In order to get only that data which is most useful, the regular expression [WWW3] technique was used. Regular expressions are series of characters which can be described as regular expressions. In practice they have found a wide range of application, since they make it possible to very easily input a text sample, while the existing algorithm efficiently determines if the given series of characters matches the sample or it searches the text for appearances of the sample. An example of such an expression could be:

Postcode: [0-9][0-9]-[0-9][0-9][0-9]

E-mail: ^[_a-zA-Z0-9-]+(\.[_a-zA-Z0-9-]+)*@[a-zA-Z0-9-]+(\.[a-zA-Z0-9-]{1,})*\.([a-zA-Z]{2,}){1}$

The selection of the proper expressions is key. Inappropriate expressions may cause errors or inconsistency in the retrieved data. In the test phase, the data are logged which makes it possible to later verify or correct the data. In case of real estate offers, portals typically have a well developed structure, which facilitates adding new advertisements. This simplifies the way that the regular expressions are formulated. For example if information on a particular variable (e.g. rental costs) is embraced with HTML tags in the following format:

```
<p class="data">
<spanclass="etykieta">Wysokość czynszu:</span>
<span class="opis">300 PLN</span>
</p>
```

regular expression to retrieve this information might take the following form:

```
<spanclass="etykieta">Wysokość czynszu:</span>[\s]*<spanclass="opis">)([0-9,.]+?)(?=[A-Z\s]*</span>
```

In this examples the expression ([0-9,.]+?)(?=[A-Z\s] was used, that selects any number that is situated in front of the text. Below are further examples used in the system for retrieval of real estate offers:

City name: "((?<=miejscowo.+(<a href=./sprzedaz/[a-z]+/[a-z-]+.>)|([:]{7}))[\w\s.-]+)"

Disctrictname: "((?<=dzielnica.+<a href=./sprzedaz/[a-z/-]+/[a-z/-]+.>)[\w\s.-]+)"

Primary/secondary market (:"(?<=<dd[a-z=]*>)(wtórny|pierwotny?)"

Construction material: "(cegła|drewno|pustak|keramzyt|wielkapłyta|beton|silikat|betonkomórkowy|inne?)"

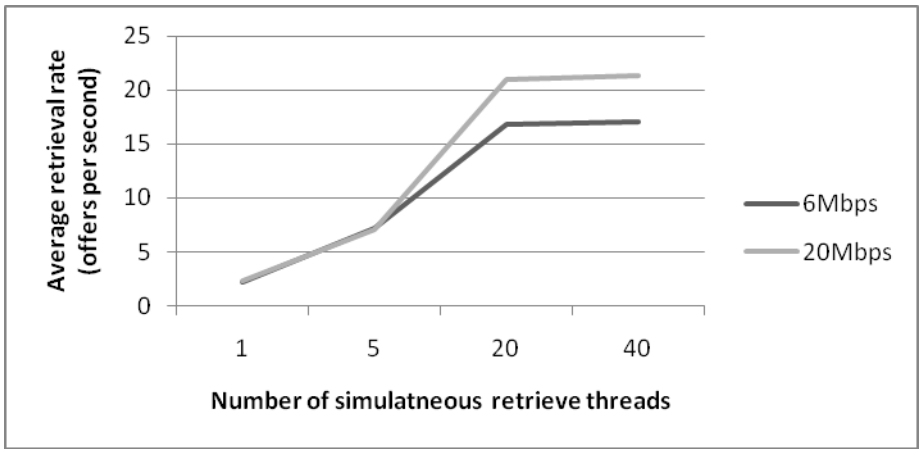
Heating: "(?<=ogrzewanie:.)(miejskie|gazowe|piece kaflowe|elektryczne|inne?)"

The database consists of 31 tables making use of the relations and links between them. Each bit of retrieved data has two tables: the first stores the raw data in a numeric format while the second is a knowledge table. Such a database design was dictated by the fact that a very large amount of information is to be stored in it – currently there over 3.5 million records.

Benchmarking the speed of data retrieval

Currently data is retrieved from one of the largest real estate portals. The system is designed to easily be scaled for other portals. The data has been retrieved at monthly intervals since December 2009. On average 300,000 real estate ads are retrieved however there is a noticeable rising trend in the number from month to month. Such an amount of data requires strong focus on optimization of algorithms used to make this process efficient. Benchmark analysis was used to analyze the most important factors (number of threads, Internet connection speed) that influence the speed of data retrieval and thus to identify the possible bottlenecks.

The analysis was carried out with two connection Speer 6 and 20 Mbps. The system was set to retrieve data from 100 and 1000 offers.



Source: IE UITM.

Table 1

Internet connection: **6Mbps**

Number of threads	100 offers		1000 offers		Average
	Time [s]	Offers/s	Time [s]	Offers/s	Offers/s
1	44,11	2,3	455,29	2,2	**2,2**
5	10,00	10	233,05	4,3	**7,1**
20	4,74	21,1	79,93	12,5	**16,8**
40	4,67	21,4	78,99	12,7	**17**

Source: IE UITM.

Table 2

Internet connection: **20Mbps**

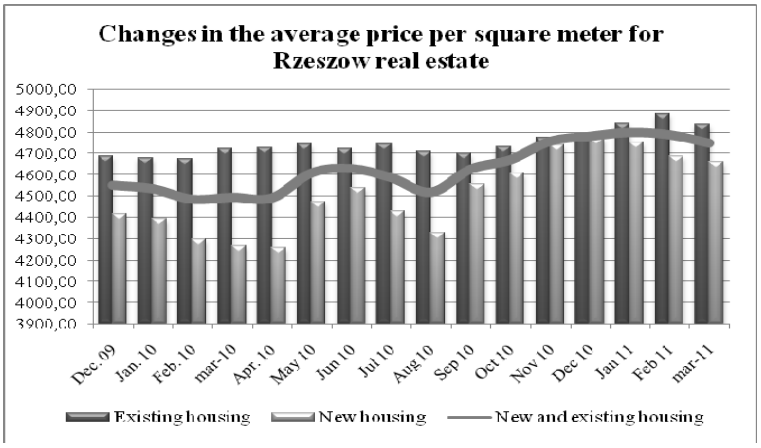
Number of threads	100 offers		1000 offers		Average
	Time [s]	Offers/s	Time [s]	Offers/s	Offers/s
1	42,19	2,4	447,21	2,2	**2,3**
5	10,38	9,6	217,80	4,6	**7,1**
20	4,53	22,1	50,27	19,9	**21**
40	4,57	21,9	48,18	20,8	**21,3**

Source: IE UITM.

The analysis indicates that the connection speed doesn't influence retrieval speed in case of low number of simultaneous threads. With increased number of threads to 20 the role of connection speed increases, offering on average 25% faster retrieval speed in case of 20Mbps compared to 6Mbps. Further increase of threads doesn't improve the situation. There might be various factors, that require further research (e.g. connection speed of the source, performance of the computer equipment used for retrieval).

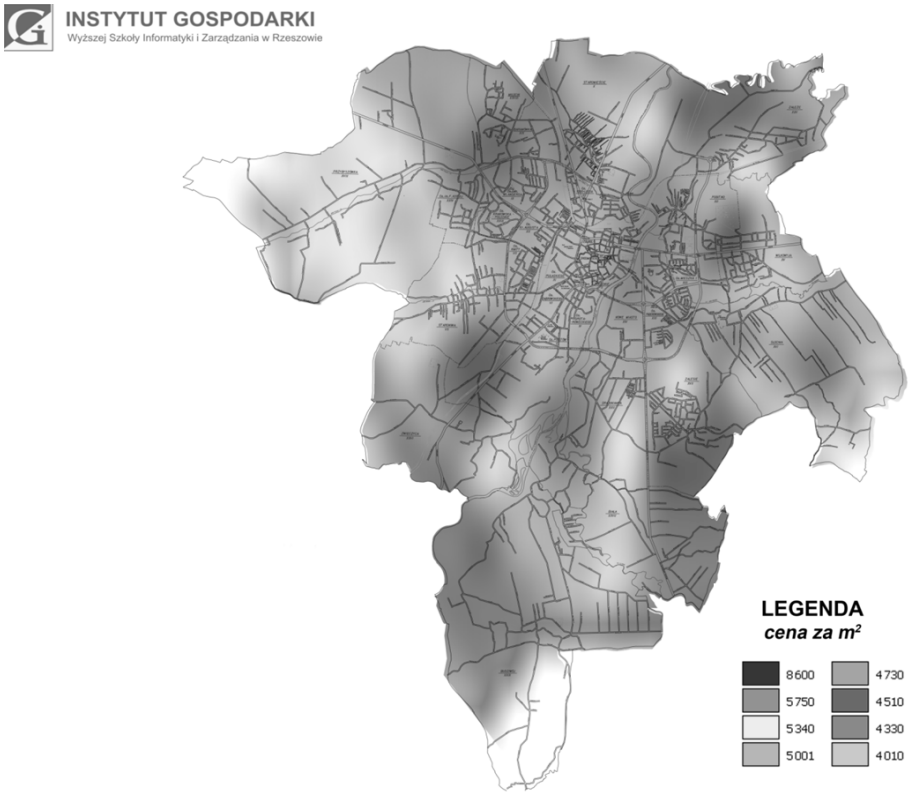
Usefulness of web harvesting for further research

Retrieving large quantities of data in this way facilitates analysis which previously was either impossible or unfeasible. One of the ways in which the data can be used is in the analysis of any changes in the number of advertisements or the average price per square meter as well as forecasting of these changes.



Source: IE UITM.

Another analysis which this data makes possible is the visualization of changing real estate prices. To do this an external GIS software is required. MapInfo by Pitney Bowes Business Insight is such a program. By using the overlays of Vertical Mapper it is possible to interpolate pricing points of real estates in layers and to better depict the range of real estate prices. Such uses of the data are many, and could include creation of a system for an Automated Valuation Model use of the Data Mining technique to discover the links between the data.



Graphic 2. Range of average real estate prices per square meter in the city of Rzeszow in March 2011

Source: IE UITM.

Future applications

The system that was primarily developed for real estate data retrieval through 15-months testing and fine-tuning period proved its usefulness and validity for various research and exploitation purposes:

- analysis of structure and dynamics of variables,
- forecasting,
- developing automated value models.

Such analysis attracted so far attention of various press institutions as well as real estate brokering institutions. It is envisaged that similar processes for web data retrieval will be applied for other areas and industries, including: social media, automotive offers, job offers. Huge collections of data, already cleaned and saved in usable formats for further statistical analysis might inspire, especially young scientists for data exploration. The future work planned by the Institute of Economics regarding data retrieval system can be divided into three areas:

1. Monthly based data retrieval for real estate market – regular updates of the system.
2. Development of user friendly interface for easy integration of the system with other web data sources, requiring minimum programming skills.
3. Development of data visual exploration tools, that could be embedded on the website.

Literature

[WWW1] http://en.wikipedia.org/wiki/Web_harvesting
[WWW2] http://www.computerworld.com/s/article/93919/Web_Harvesting
[WWW3] http://en.wikipedia.org/wiki/Regular_expression

Streszczenie

Web harvesting to nowa technika używana do zbierania, ekstrakcji i integracji danych z różnych źródeł internetowych poprzez wykorzystanie robotów indeksujących, wspomaganych technologią filtrowania danych z użyciem wyrażeń regularnych. W sytuacji gdy zaistnieje konieczność zgromadzenia danych pochodzących z różnych stron internetowych, które mają niejednorodną budowę, strukturę i nazwę, typowe dostępne na rynku oprogramowanie web harvesting działające automatycznie lub półautomatycznie nie jest już wystarczające. Artykuł

przedstawia architekturę systemu stworzonego przez Instytut Gospodarki z Rzeszowa, która służy do zbierania danych z portali rynku nieruchomości. W dalszej jego części zaprezentowano analizy oraz potencjalne zastosowanie aplikacji w naukach społecznych.

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CREATIVITY-ORIENTED BUSINESS PROCESS MANAGEMENT SYSTEM

Introduction

In recent times, organizations are starting to replace their attention from highly standardized business processes applied in production industry to other types of processes that can't be easily replicated due to the knowledge dimension, intelligence, talents and creativity of people involved, such as service processes and creative processes. An organization's ability to being creative and innovate is of increasing importance in markets that are overflowed with commodity products and services. In paper author suppose that each creative process implemented in an organization might be treated as business process. The paper also introduces the knowledge dimension of creative business processes and uses it to illustrate that the existing Business Process Management (BPM) systems are not suitable to support these type of processes. The paper argues that, in the case of creative business processes the classical criteria such as cost, time and efficiency cannot been used successfully. So, the very big importance get such criteria as quality and creativity.

Related Works

While the main objective of classic BPM and workflow is to automate routine tasks and procedures, creativity-oriented BPM aims to support human beings in performing creative, knowledge-intensive work.

Until recently, the concept of creativity relate exclusively to the work of artists, painters, poets, writers, designers, composers and others, as well as scientists and inventors. However, this term today has become much wider. In accordance with the recognition of Psychology, creativity is deeply rooted in human nature and as such is entitled to all people, regardless of the nature

of their activities. Creativity is not only the prerequisite for innovation and, thus, a core competitive factor in contemporary organizations [Seid08]. Creativity has influence on a lot of business processes and some of them are always creativity-oriented.

There are a lot of works about creativity in business. However, just some of them describe the meaning and challenge of analysis of creative business processes.

Togar M. Simatupang, Indah Victoria Sandroto and S.B. Hari Lubis in 2004 examine coordination mechanisms and their determinants in the creative design process of a fashion firm [Sima04]. It is argued that coordination mechanisms are driven by a set of three determinants, namely responsibility interdependence, uncertainty, and conflict. Findings from the case study are presented and areas for future research are provided.

In their article "Business Process Management for the Creative Industries" Stefan Seidel, Michael Rosemann, Arthur ter Hofstede and Lindsay Bradford have presented the research project of applying business process management to the screen business and thus aims at converting tacit knowledge into explicit process knowledge building business process reference model for the this business [Seid06]. They also made a lot of case studies with organizations from the creative industries (film industry, visual effects production, etc.,). On the basis of this studies Stefan Seidel and Michael Rosemann suggest that "BPM can be a facilitator providing the glue between creativity management and well-established business principles". In article "Creativity Management – The New Challenge for BPM" the authors introduce the notions of creativity-intensive processes and pockets of creativity as new BPM concepts [Seid08].

The paper "Extending the boundaries of business process management: from operational to creative business processes" illustrates why the existing (BPM) and collaborative systems are not suitable to support these knowledge intensive processes. The paper argues that, in the case of creative business processes, process support needs to co-evolve with process execution itself through the accumulated experience [Marj08].

The related works shows that 80-90% of all work processes cannot be completely analyzed using BPM system, such as improvised processes, decision processes and especially creative processes that bring most companies their competitive advantage and create the most business value. To unleash its power for radically transforming the way of doing business, BPM systems not yet focusing on the core processes of innovation, rather than administration and production routine processes.

What is creativity?

Term "creativity" has a different character. There is no commonly accepted definition in the rich literature on the subject. According to Morris Stein "creativity – the process is carried out to the new work, which is accepted as useful or acceptable for a certain group in a certain period" or "creativity is the ability to find ideas that are both novel and useful" [Stei60]. Richard Dobbins and Barrie O. Pettman describe the creativity as the ability to improve, whereby through improvement value is added [Dobb97]. They said that term "improved" may be in reference to the individual person, or to the society or domain within which the work occurs. "Valuable" is similarly defined in different ways, but usually through its comparative uniqueness. Creativity can also be described as the ability of the person to produce works of characterized by conjunction of two characteristics: novelty and valuable [Neck03]. That means the new works, but worthless can't be named as "creative", like as the valuable, but not new ones.

As a consequence, creativity may be considered within four categories:

- creativity as a work,
- creativity as a process,
- creativity as a set of intellectual capacity, or combination of personal characteristics,
- creativity as a set of social promoters.

Hartley's opinion that "creativity will be the driver of social and economic change during the next century" is reassuring for the creative industries but in order to stay competitive the industry should apply the contemporary business approaches, such as business process management [Hart05]. Bilton in his book "Management and Creativity" notes that "[…] creativity and business are not natural opponents – they have more in common than we may assume" [Bilt06]. So, whether could be assumed that the creative process applied in organization, have to be understand as a business process? Firstly, it need to be defined, what creative process is.

What is creative process?

The creative process has a long history of being systematized and divided into phases. One of the earliest models of the creative process is belonged to Graham Wallas [Wall89]. The author suggest that creative thinking proceeds through four stages:

– preparation (definition of issue, observation, and study),
– incubation (laying the issue aside for a time),
– illumination (the moment when a new idea finally emerges),
– verification (checking it out).

The inclusion of incubation followed by sudden illumination in Wallas model is explain why so many people treated creative thinking as a subconscious mental process that cannot be directed. Wallas model is the basis for most of the creative thinking training programs till now.

Another interesting model of creative process is Barron model [Barr88]. Barron in 1988 paid great attention on subconscious and chance processes in his "psychic creation model":

– conception (in a prepared mind),
– gestation (time, intricately coordinated),
– parturition (suffering to be born, emergence to light),
– bringing up the baby (further period of development).

However, not all the models place the generation of new concepts in the mind. Fritz in 1991 built the model, in which identifies the beginning of the process "as the creative acts of conception and vision, which is followed by analysis of current reality, action, evaluation, public scrutiny (building momentum)". The main phases of this process are:

– conception,
– vision,
– current reality,
– take action,
– adjust, learn, evaluate, adjust
– building momentum,
– completion,
– living with your creation.

Fritz explain that the creative process is cyclical in nature. "Living with your creation" means purposeful noticing and analysis that leads to the appearance of next creative conception [Frit91].

Despite of there are plenty of models for the creative thinking process, it is easy to define the consistent characteristics that aggregate them all:

1. The creative process involves complete analysis, imaginative idea generation, and evaluation made by creator.
2. Older models suggest that creative ideas result from subconscious processes, usually outside the control of the creator. Modern models tend to imply the generation of new ideas, under the direct control of the creator.
3. The creative process is cyclical.

4. The creative process it is not only the ideas creation. Humans must do more than simply imagine new things, they must work hard to make them concrete realities. So, the creative process is a balance of work and imagination.

The creative processes are knowledge-intensive processes. Usually these processes are also unpredictable, emotion-intensive and, as a consequence, difficult and sometimes even not impossible to model in terms of their process flow by means of classic diagrams.

The main challenge in BPM modeling is description of the highly agile nature of creative processes. The question arises whether the creative processes involved in the activities of the organization may be treated as a creative business processes?

Creative Business Process

Analyzing one of the most widespread definition of business process: „[…] this is the course of the consequent business operations, which have a beginning and an end, and clearly defined contribution and results, leading to achieve the effect that have value for the customer" [Gabr00]. It is easy to see that the creative process also has a beginning and the end of material, physical or/and mental contributions. Furthermore, in a result of the creative process making the valuable for the end-user (customer or internal organization) work is created, for example: project, website, lecture, book, etc. It is means that each creative process implemented in an organization might be treated as business process.

The definition of creative process suggest, that each creative business process should be primarily described by novelty and valuation (Figure 1). It is very hard to explain nature of this criteria using numbers. Different persons understand the novelty and valuation in different way. Furthermore, each of this criteria can be analyzed separately, but their using in order to identify the power of creativity makes sense only in sum.

To improve creative process the organization should know that factors have influence on creator during the work-making and which of them have positive or negative influence on the author. The success of creative process realization depends on emotional statement of creator, that's why it is also important to know how the emotions modify during this process. The creative process graphical representation (model) should illustrate the consequence of emotional statements. Of course, the classical parameters, such as time and cost should be also estimated, however in context of creative process they has lesser importance.

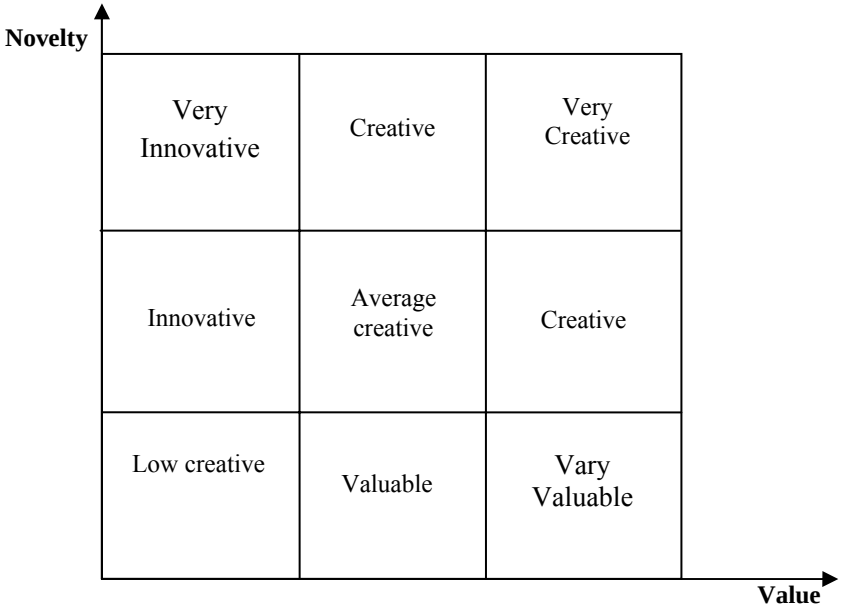

Figure 1. The matrix of creative process structure

BPM Creativity-Oriented System Model

In order to build the creativity-oriented BPM system, author proposed the new matrix of business process classification according to repeatability and creativity, which include three types of business processes: routine, improvised, creative (Figure 2).

Routine processes are the repeatable schemes of actions based on the people experience, which could be characterized by high repeatability and low creativity such as: production technology, simple operation tasks, check issue, order realization, products delivery etc.

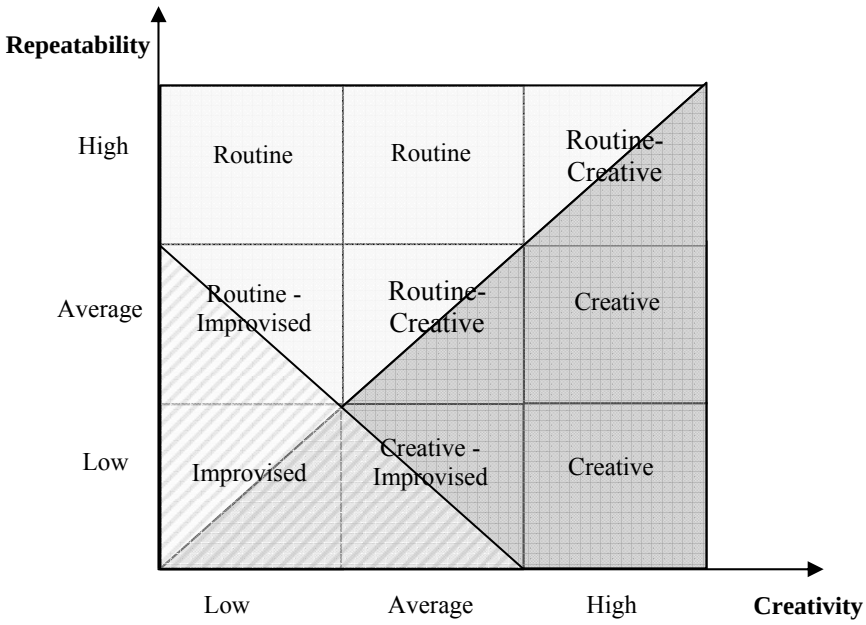

Figure 2. The matrix of business process classification according to repeatability and creativity

Improvised processes the unique schemes of action based on the people experience, which could be characterized by low repeatability and low creativity: atypical contracts realization, changing of technology in the result of failure, reaction in the case of delivery failure etc.

The recent BPM systems are concentrated on routine processes, the improvised and creative processes are usually missed. According to proposed creativity-oriented classification the architecture of BPM system might be constructed as Figure 3 shows. Each module should have its own set of models and set of process criteria (parameters). Because it is very hard to explain nature of this criteria using numbers, the architecture of each module have to include the Artificial Intelligence Techniques [Szyj11].

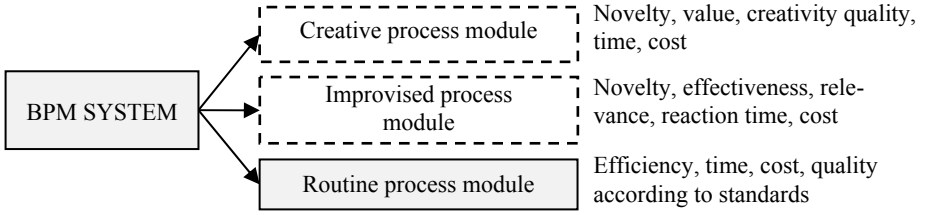

Figure 3. The main modules of creativity-oriented BPM system

Summary

The related works shows that creative processes cannot be completely analyzed using BPM system. The recent BPM systems usually concentrated on routine processes, the improvised and creative processes not take into consideration, although the research prove that each creative process applied in enterprise can be treated as business process. The creativity-oriented BPM system proposed in paper ought to fix this imperfection. That means we have to reoriented the architecture of BPM system taking the creativity and knowledge resources into consideration.

Literature

[Barr88] Barron F.: Putting Creativity to Work. The Nature of Creativity. Cambridge University Press, Cambridge 1988.

[Bilt06] Bilton C.: Management and Creativity: From Creative Industries to Creative Management. Madlen 2006.

[Dobb97] Dobbins R., Pettman B.: Self Development: Thew Nine Basic Skills for Business Success. "The Journal of Management Development" 1997, Vol. 16, No. 8.

[Frit91] Fritz R.: Creating. Fawcett, New York 1991.

[Gabr00] Gabryelczyk R.: Reengineering: Restrukturyzacja procesowa przedsiębiorstwa. Wydział Nauk Ekonomicznych UW, Warszawa 2000.

[Hart05] Hartley J.: Creative Industries – Introduction. In: Creative Industries. Ed. J. Hartley. Madlen 2005.

[Marj08] Marjanovic O.: Extending the Boundaries of Business Process Management: From Operational to Creative Business Processes. 30th International Conference on Information Technology Interfaces, Dubrovnik 2008.

[Neck03] Nęcka E.: Psychologia twórczości. GWP, Sopot 2009.

[Prat04] Pratt A.: Creative Clusters: Towards the Governance of the Creative Industries Production System. "Media International Australia Incorporating Culture & Policy" 2004.

[Seid07] Seidel S.: A Business Process Management Perspective on Creativity: Creativity Intensive Processes. AMCIS 2007 Proceedings, Paper 417.

[Seid08] Seidel S., Rosemann M.: Creativity Management – The New Challenge for BPM. www.bptrends.com

[Seid06] Seidel S., Rosemann M., Brandford A.: Business Process Management for the Creative Industries: Facing Challenges Arising from Globalization and New Technology. Beijing Forum 2006.

[Sima04] Simatupang T., Sandroto I., Lubis S.: A Coordination Analysis of the Creative Design Process. "Business Process Management Journal" 2004, Vol. 10, Iss. 4.

[Stei60] Stein M., Heinze S.: Creativity and the Individual. The Free Press, Chicago 1960.

[Szyj11] Szyjewski Z., Pilipczuk O.: Model systemu monitorowania jakości procesów organizacji usługowych. Problemy Zarządzania, Warszawa 2011.

[Wall89] Wallace D., Gruber H.: Creative People at Work. Oxford University Press, New York 1989.

Streszczenie

W ostatnich latach organizacje zaczynają koncentrować swoją uwagę nie na wysoce znormalizowanych procesach biznesowych stosowanych w przemyśle i produkcji, lecz na innych typach procesów, które nie mogą być często i łatwo powtarzane z powodu wymiaru wiedzy w nich zawartej, inteligencji i kreatywności, czyli procesach usługowych i twórczych. Umiejętność wykorzystywania twórczości i innowacji przez organizację ma coraz większe znaczenie na rynkach, które są nasycone produktami i usługami. W artykule założono, że każdy proces twórczy wdrożony w organizacji może być traktowany jako proces biznesowy. Pokazano również, że istniejące systemy zarządzania procesami biznesowymi (BPM) nie są odpowiednie do obsługi tych rodzajów procesów. W odniesieniu do twórczych procesów biznesowych klasyczne kryteria, takie jak koszt, czas i wydajność, obecnie nie są pomyślnie wykorzystywane w systemach typu BPM. Ponadto w artykule zaprezentowano klasyfikacje procesów biznesowych ze względu na ich powtarzalność i kreatywność. Na podstawie proponowanej klasyfikacji zaproponowano architekturę systemu BPM zorientowanego na procesy twórcze.