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EVALUATING TECHNICAL EFFICIENCY OF IMPLEMENTING A KNOWLEDGE MANAGEMENT SYSTEM

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Abstract: For the past years knowledge management has become the method for obtaining competitive advantage, considering that knowledge is an infinite resource, and a knowledge management system – the instrument. In this context, evaluating the efficiency of implementing a knowledge management system has become the hottest topic for the past years. Using the subtle sets theory' method and techniques, the paper aims to solve the problem of evaluating the technical efficiency of implementing a knowledge management system in organizations, profit or non profit organizations, either production or services organizations.

1. Introduction

The concept of knowledge management has arisen from the necessity of balancing the need for resources with the stocks of resources, considering the last as being finite in relation with the continuously growing necessities of the organizations. Thus a new resource started to be exploited, knowledge, and the processes – generating, stocking, using, organizing - concerning this resource has been grouped within the concept of knowledge management. A modern instrument is nowadays used in order to better accomplish an organization goals related to knowledge management, a knowledge management system, and evaluating the efficiency of its implementation represents the main challenge for the researchers and experts in the field, because knowledge management systems must prove their value to organization and it has to be value-added. There are several methods used in order to accomplish this task, but they are mainly based on intellectual capital, not on knowledge.

2. Knowledge management systems efficiency

A knowledge management system is represented [Wiig, 1999; ISSCO, 1996; Bixler, 2005; Dalkir, 2005] by instruments, mainly software applications that support knowledge management, evolving from information management instruments with an accent on their capacity to facilitate communication, through e-mails and forums, to coordinate the users activity, through calendars and tasks lists, to enable collaboration between users, through common use of resources and control, through internal audit and automatic control of tasks.

A knowledge management system is defined [Luban, 2006, p.27] as a set of "instruments for the knowledge management, that help organizations in their activities to solve the problems and to facilitate the decision process". The general model of knowledge

management system architecture [Luban, 2006] is represented by the combination of the following three types of services: presentation services – personalization and visualization; knowledge services – creation of knowledge, sharing knowledge and reuse of knowledge.

Related to the evaluation of implementing knowledge management system technical efficiency, there are presently used the following methods [CWA, 2004, Van Der Westhuizen, 2005, Malhotra, 2003, Ioniță, 2004]:

- methods based on input-output-processes - including methods based on quality management: Skandia Navigator, Intellectual Capital Index, Intangible assets monitor, Balanced scorecard, House of quality;
- methods based on cause-effect relation: Citation-weighted Patents and technology broker;
- new methods: performance indicators, qualitative success cases method, direct methods for evaluating software applications, functional score method

All of these methods have advantages and disadvantages, related to the duration of evaluation, the lack of a composite numerical/financial index, difficulties in comparisons, benchmarking between organizations, mainly because of their specificity related to intellectual capital approach, which is a wider concept than knowledge.

The use of subtle sets theory generate a more accurate instrument for evaluating a knowledge management system implementation technical efficiency, eliminating the impediments of the intellectual-based instruments, allowing the combination of qualitative and quantitative evaluation criteria and resulting a single indicator that may be used in comparisons between organizations.

3. The methodology for evaluating knowledge management system technical efficiency implementation

According to subtle sets theory [Osmătescu, 1997; Stoica, 2003; Stoica, 2004], a subtle set is represented by fuzzy sets that describe, using different criteria, the same general characteristic. In this case, the characteristic - EF_0- is "the technical efficiency of implementing a knowledge management system" into organization, and is defined by some criteria, determined by the application of brainstorming and Delphi technique on a group of ten experts on evaluation and considering the contribution of knowledge and knowledge management to an organization performances [Nicolescu, 2005] and the model of knowledge management system architecture [Luban, 2006].

The antithetical characteristic, according to the same theory, "technical inefficiency of implementing a knowledge management system" into an organization was annotated $\overline{EF_0}$. Also, on the first level of aggregation/on the second level of aggregation there are used the following quantitative criteria/primary indicators:

C_1^0) the efficiency of presentation services:

C_{11}^0)the degree of personalization, measured through the number of personalized users accounts/total number of users;

C_{12}^0)visualization degree, measured through the number of minutes for searching information and knowledge on week;

C_2^0) the efficiency of knowledge services:

C_{21}^0)the use of technologies for creating knowledge through exploitation, measured through the medium number of relations between knowledge and information identified by the users based on the use of system on week;
C_{22}^0) the use of technologies for creating knowledge through exploration, measured through the total number of knowledge-based scenarios communicated on week;
C_{23}^0) the use of technologies for creating knowledge through codification, measured through the total number of knowledge of experts registered into knowledge bases on week;
C_{24}^0)the efficiency of collaboration technologies, measured through the economy of time necessarily for daily planning;
C_{25}^0)the degree of reuse, measured through the number of "good practices" registered into the knowledge bases/total number users;
C_3^0) the efficiency of infrastructure services:
C_{31}^0) the efficiency of memorization service, measured through the number of knowledge categories stocked/total number of knowledge categories;
C_{32}^0) the efficiency of communication services, measured through the time used for communication in the virtual environment/total time necessarily for communication on week;
C_{33}^0) the efficiency of collaboration services, measured through the economy of time necessarily for physical meetings.

Similarly, there were established the antithetical quantitative criteria/primary antithetical indicators to define $\overline{EF_0}$ the inefficiency of implementing a knowledge management system into an organization.

Because there are not any organization in Romania that have implemented a knowledge management system, all the primary indicators were considered for now qualitative and were evaluated by the ten experts, based on a form that asked them to choose for every indicator a score between 1 and 10, according to the degree of their appreciation on the future evolution of the indicators.

Afterward every value was transformed, standardized, based on membership degree function (1), were x represents the values admitted by experts and the redundancy [Stoica, 2004] eliminated, through calculating the correlations ρij between criteria.

$$f(x,4,8,10)=\begin{cases}0, x \le 4\\ \dfrac{x-4}{8-4}, 4 \le x \le 8\\ 1, 8 \le x \le 10\end{cases} \qquad (1)$$

A composition law for the primary criteria was used (2), the value of exponents being corrected with corrections like (3) and then, on the first level of aggregation was used the same composition law, according to the subtle sets theory [Osmătescu, 1997; Stoica, 2003; Stoica, 2004].

$$\Psi_m^0(x_j)=\pi_j\mu_j^{\alpha j0} \qquad (2)$$

Where
μ_j represents the medium value of membership degree for the primary indicators;
α_j represent exponents for the quantification of importance of the indicators.

$$\mu_j' = \mu_j^{(1-\rho ij)}, \text{ for simple redundancy, between two indicators} \qquad (3)$$

Where
μ_j represents the medium value of membership degree of each indicator
ρij represents the simple correlations.

The following correlations were identified and, accordingly, the redundancy afterwards, eliminated:
- C_{12}^0)visualization degree, measured through the number of minutes for searching information and knowledge on week and C_{21}^0)the use of technologies for creating knowledge through exploitation, measured through the medium number of relations between knowledge and information identified by the users based on the use of system on week;
- C_{12}^0)visualization degree, measured through the number of minutes for searching information and knowledge on week and C_{22}^0) the use of technologies for creating knowledge through exploration, measured through the total number of knowledge-based scenarios communicated on week;
- C_{12}^0)visualization degree, measured through the number of minutes for searching information and knowledge on week and C_{25}^0)the degree of reuse, measured through the number of "good practices" registered into the knowledge bases/total number users;
- C_{25}^0)the degree of reuse, measured through the number of "good practices" registered into the knowledge bases/total number users and C_{31}^0) the efficiency of memorization service, measured through the number of knowledge categories stocked/total number of knowledge categories;
- C_{24}^0)the efficiency of collaboration technologies, measured through the economy of time necessarily for daily planning and C_{32}^0) the efficiency of communication services, measured through the time used for communication in the virtual environment/total time necessarily for communication on week;
- C_{24}^0)the efficiency of collaboration technologies, measured through the economy of time necessarily for daily planning and C_{33}^0) the efficiency of collaboration services, measured through the economy of time necessarily for physical meetings.

In the end, EF_0 calculated value was 0.9973, and similarly $\overline{EF_0}$ calculated value was 0.9869, and the discrepancy between efficiency and inefficiency was determined, the calculated value being 0.0104; there can be concluded that the technical efficiency of implementing the system is greater than the technical inefficiency; the action of implementing the knowledge management system would have sense and value from the technical point of view, according to the evaluation experts.

4. Conclusions

The mass use of instruments based on intellectual capital for evaluating the implementation efficiency of a knowledge management system into organizations is a justified action if the impact of knowledge management over the organization performances is considered, known that the use of knowledge management conduct to the development of intellectual capital [CWA, 2004].

Also mass use of instruments based on quality management for evaluating the implementation efficiency of a knowledge management system into organizations is a justified action if the relation between the two concept is considered [Ribiere, 2004].

The most important matter of the moment, along with eliminating the barriers that are impediments for knowledge management systems and knowledge management implementation, is evaluating the effects and effciency of implementing such system into organizations. The instrument proposed in this paper is an efficient and alternative one, based on the newest theory used nowadays, the subtle sets theory, that allow the evaluation both of

quantitative and qualitative effects, the instrument eliminating the disadvantages of the ones used before.

Based on the pertinent opinions of the experts in evaluation, considering the role of knowledge and knowledge management system within organizations and the benefits of knowledge management, such a system must be implemented by organizations in order to better achive organizational goals and competitive advantage.

Bibliography

1) [Bixler, 2005] Bixler, C., *Developing a foundation for a successful knowledge management* system, in Stankosky , M., *Creating the discipline of knowledge management*, Elsevier, Oxford, 2005, p. 51-65
2) [CWA, 2004] European Committee For Standardization, *CEN Workshop Agreements*, Management Centre, Brussels, March 2004, available at http://www.cenorm.be/cenorm/businessdomains/businessdomains/isss/cwa/index.asp?pClose=3
3) [Dalkir, 2005] Dalkir, K, *Knowledge management in theory and practice*, Elsevier, Oxford, 2005
4) [Ioniță, 2004] Ioniță, I., Bănacu, C.S., Stoica, M., *Evaluarea organizațiilor*, Editura Economică, Bucureşti, 2004
5) [ISSCO, 1996] ISSCO Projects and Research Activities, Evaluation of Natural Language Processing Systems - FINAL REPORT, University of Geneva, Switzerland, 1996, discponibil la: http://www.issco.unige.ch/projects/ewg96/ewg96.html
6) [Luban, 2006] Luban, F., *Sisteme bazate pe cunoştințe în management*, Ed. ASE Bucureşti, Bucureşti, 2006
7) [Malhotra, 2003] Malhotra, Y., Measuring Knowledge Assets of a Nation: Knowledge Systems for Development. [Online], 2003 available at: http://www.kmnetwork.com/knowledgeManagementMeasurementResearch.pdf
8) [Nicolescu, 2005] Nicolescu, O., Nicolescu, L., *Economia, firma şi managementul bazate pe cunoştințe*, Ed. Economica, Bucuresti, 2005
9) [Osmătescu, 1997] Osmătescu, P., *Basis of the Subtle Spaces and Algebrical Structures'Mn: Scripta scientiarum mathematicarum*, tomul I, fasciculul I. Ed. Chişinău, 1997, pag. 196-209
10) [Ribiere, 2004] Ribière, V., Khorramshahgol, R., *Integrating Total Quality Management and Knowledge Management*, Journal of Management Systems, Maximilian Press, Publisher Integrating Total Quality Management and Knowledge Management, Vol. XVI, No. 1, 2004, p. 39-45
11) [Stoica, 2003] Stoica, M., Doval, E., *Aplicatii ale operatorului de act in economia firmei* (in memoria matematicianului roman Petre Osmatescu). ARA Journal, vol. 25/2003, p. 50-62
12) [Stoica, 2004] Stoica, M., Ratiu-Suciu, C., *Modelarea proceselor investiționale cu baze de cunoştințe*, Revista ECONOMIA 2-2004, Editura A.S.E., Bucuresti, 2004, p. 24-32
13) [Van Der Westhuizen, 2005] Van Der Westhuizen , C., *Intellectual capital management in a retail company in South Africa*, Dissertation paper, University of Johannesburg, 2005
14) [Wiig, 1999] Wiig, K., *Knowledge Management: An Emerging Discipline Rooted in a Long History*, Knowledge Research Institute, Draft of Chapter 1 in Knowledge Management, Edited by Daniele Chauvel & Charles Despres, 1999