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The Missing Link in the Integration of Knowledge Management Practices and Technological Solutions

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THE MISSING LINK IN THE INTEGRATION OF KNOWLEDGE MANAGEMENT PRACTICES AND TECHNOLOGICAL SOLUTIONS

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ABSTRACT

The development of knowledge management tools shows a difference between the information system practice and the non-technological solutions: most of the time, the direction of the efforts is not presenting the same way, and not integrating each other. It is the same in the real life practice: there is a problem that the technological tools are not able to give an efficient support to the practice of the company. In this paper an integrated framework is developed to assign the right technological solutions for organisational demands.

1. INTRODUCTION

Technological developments have a big role to enable the effective knowledge management, but several authors argue, that knowledge management is not equal to only information technology [Gubley, 1998; Hildebrand, 1999; Whiting, 1999; Dougherty, 1999]. Gubley is mentioning, that information technology is "certainly necessary", but not sufficient condition of efficient practice of knowledge management.

Several frameworks exist in the area of knowledge management, trying to discover the main steps of the eliciting, distributing, store and creating knowledge. These frameworks concentrate mainly on the process of knowledge leveraging and new knowledge creating, but do not observe the related technical possibilities.

On the other hand, IT developers concentrating on technological solutions, that presents sometimes little relationship to the business problems. There are only a few initiatives, which are trying to eliminate this difference between these parties [Hendriks and Vriens, 1999; Wielinga et al, 1997; Wiig et al, 1997; van der Spek and de Hoog, 1995]. Sveiby differentiates two interpretation for the concept of knowledge management: one stream is the IT oriented, and the other one is people oriented [Sveiby, 2001]; this interpretation is similar to Wiig's approach [Wiig, 2000].

Most of the companies are planning their knowledge management activities, as an investment into a search engine, portal, or document content management solution, although there are several tools supporting knowledge management [Simon, 2001]. According to many surveys on knowledge management practice, companies are primarily using online information systems, groupware solutions and document management systems as knowledge management technologies. The rate of using other technologies is rather low [KMRR, 2000; CKMID, 2001; Rowley, 1999], although companies are

counting KM "extremely important". By choosing the less complex solutions, organisations are renouncing the possibility to achieve higher efficiency.

The focus of this paper is to situate the concept of knowledge management in a wider approach, through analysing the relation to the corporate strategy, IT strategy and technological solutions in order to explore the possibilities to achieve higher organisation efficiency. Therefore the opportunities, which the technological solutions can offer, must be deeply analysed and assessed, which is also the task of this framework.

2. OVERVIEW OF RELATED IT SOLUTIONS

Many authors [Davenport and Prusak, 1999; Schreiber et al., 1998; Wiig, 2000] trace back the concept of knowledge to such well interpreted concepts, as data and information. In this case data is uninterpreted series of signals, information is interpreted data which changes the uncertainty of the environment and gives meaning for data, and knowledge is the usability of information, which indicates action. This approach is using a more material, IT focused definition, rather than philosophical approaches [Polányi, 1966, 1994; Nonaka and Takeuchi, 1995]

This interpretation helps IT professionals to handle the problems of knowledge management in the frame of the traditional view. There could be also higher levels at the interpretation of this concept-pyramid, for instance wisdom or understanding, but these concepts are mainly not related to the area of information technology.

Wilson approaches the concept, as a part of a process, and building a processing hierarchy [Wilson, 1996]. This hierarchy is completed by the utilisation of knowledge, as decision-making and action (Figure 1.). At different levels of the hierarchy the competency of people and computers are different: at lower levels (ex. data processing) the problems, the tasks can be solved more efficient by the support of different information systems, but at top levels these tools are getting almost useless, except some hardly specialised solution. This is the area of the human brain, human behaviour.

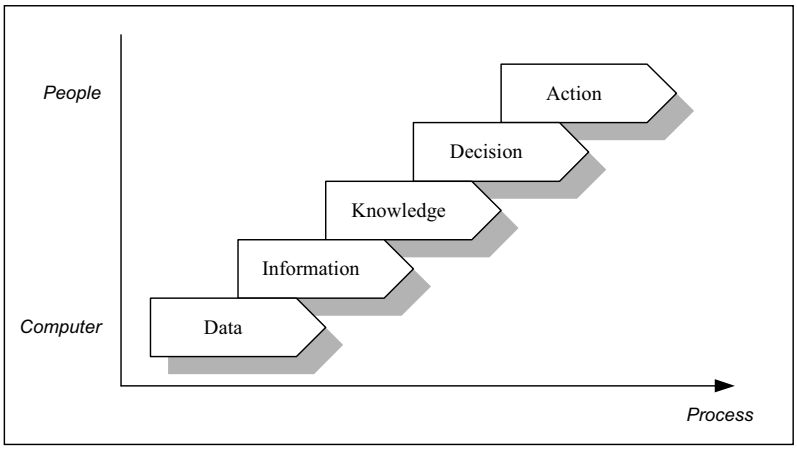

Figure 1: The processing hierarchy (adapted from Wilson [1996])

There are mellow technologies on data- and information processing and decision support systems. Nowadays the most intentions are for developing knowledge-based decision support, and problem-solving systems, mostly targeting the knowledge-use level, but aspiring to reach also the higher levels. This area of knowledge-management, knowledge-utilisation is more complex and sophisticated, and there is a big role of the human individuals.

The use of the concept "Knowledge-based systems" is very different, in the context of different authors. Sometimes this concept covers the whole area of knowledge management related systems, sometimes this concept indicates only the rule-, case- and model-based systems. Avoiding more confusing concepts, as a collecting concept, these systems can be mentioned as Knowledge

Management Support Systems (KMSS), because of the role of these systems of the organisational knowledge management efforts. In the following the most widespread IT solutions are presented.

2.1. Knowledge repositories and environment

The most widespread solutions for knowledge sharing and access are knowledge repositories and communication support systems. Most company collects the experience and cases of the employees, and stores these documents in a huge, researchable database. Corporate Intranets let the employee to reach these bases, use the knowledge and expand the base. The danger of these systems is the maintenance of the catalogue, avoiding of document loss [van Heijst et al, 1997].

Beside the traditional forms of communication (telephone, fax, e-mail, etc.), groupware systems are offering a comfortable environment for knowledge handling [Hayes and Walsham, 2001; Adoud et al, 2001; Farshcian, 2001]. These systems help to remove the geographical and time borders of the work, and mean not only a communication tool. During the multi-way sharing and reusing knowledge, documents and analysis, the deep-knowledge owner experts are identified for face-to-face consultation, and more effective tacit-knowledge sharing, consequently the document base of the system also represents the knowledge-map of the organisation.

Most of the time, the researched knowledge is not reachable, because it is not formalised, or fairly tacit. Discussion forums, billboards assist to ask different people of a specific question, and get know the relevant knowledge-holders [Sheldon, 1997; Pan and Scarbrough, 1998].

2.2. Knowledge creating methods

The origin of knowledge is not only the head of the employees, but also the collection of organisational data. Through the use of the tools of document analysis or data-mining, additional knowledge can be created.

Knowledge elicitation by using data-mining technologies means the utilisation of statistics, data-analysis, OLAP technologies [Shaw et al, 2001; Liebowitz and Beckman, 1998; Fayyad and Stolorz, 1997]. The process consists of the identification of discovery of reliable, and potentially useful patterns in data, with the help of the human users [Fayyad et al, 1996; Ingber, 1998, Zhengxin and Qiuming,, 1998].

Interpretation and structuration of data and information, embedded in organisational documents, memos, e-mails, are also beneficial tools for data creating. Several commercial tools exists, using optical caracter recognition, natural language understanding, and modelling technologies [Lang and Burnett, 2000; Abecker et al, 2000; Ahmed and Ward, 2000].

2.3. Rule-based systems

Knowledge is represented in Rule-base systems as a collection of classical „IF (x) THEN (y)“ rules. This method is used in easily formalisable and heuristic owner domains, and means a simple solution for expert-systems. There is a huge number of apllications, using this approach, from very different areas [Barr, 1999; Gamble et al, 1999; Wen and Tao, 1999]. Nowadays the Fuzzy rule-based systems are especially popular [eg. Moores, 2001; Driankov et al, 1996; Bardossy and Duckstein, 1995; Ammar and Wright, 2000].

The disadvantage of these systems is the limit of the complexity of problems. For expanding the possibilities of these systems, hiarchically built rules, and neural net connections is developed [von Altrock, 1994; Cordón et al, 2001; Pasquier et al, 2001].

2.4. Case-based reasoning

Cased-based technologies are not new. The history of the case-based reasoning begins at the end of the seventies, but these systems are becoming popular at the nineties; especially in Europe. The goal of this approach is to model the human reasoning and thinking by storing previous experiences (cases), and by solving the problems through retrieving similar experiences about similar situations from the data-base, partially reuse the experiences in different cases, and storing the new experiences. [Bergman, 1999].

The main steps of the problem solving process are introduced in the case-based reasoning cycle by Aamodt and Plaza, and developed by Göker, and Roth [Aamodt and Plaza, 1994; Göker, and Roth 1999]. There are also some previous research on the case based system working process [Riesbeck and Schank, 1989; Hammond, 1989; Kolodner, 1993]. The cycle begins with the formalisation task of a new problem. This new case is the basis of the process. At the first step a previous similar case is retrieved from the case base, in order to be reused in solving the new case. This solution is presented to the end-user, who have the possibility to verify it. This revised case is expanding the case-base for future problem solving. This last step presents the learning task of the whole system.

Several applications are developed, which present the advantages and disadvantages of this approach [ex. Shin and Han, 2001; Brown and Gupta, 1994, Bryant, 1997; Buta, 1994, Law et al, 1997, Morris, 1994; Schmidt and Gierl, 2001]. This approach is reducing the knowledge acquisition efforts, because of the self-learning methods, and requires less maintenance efforts. As disadvantage, these systems are depending on the human infrastructure, as other knowledge management support systems [Fowler, 2000].

2.5. Model-based systems

The literature of model based systems is not so wide as the case-based approach, but the beginning of its history is the same [Brooks, 1981; Hogg, 1983; Binford et al; 1989]. The basis of the model-based reasoning the abstraction, model of the reality. The computer systems, using this approach are called Model-Based Systems. These systems are able to solve realistic complex porblems. These systems consist of different models and techniques, describing and modelling the human environment. Several working solutions in wide areas exist, as electrotechnique diagnosis [Cunningham, 1998; McKenzie et al, 1998], road traffic [Koller et al, 1993; Sullivan et al, 1996],or medicine [Moghaddam et al, 1997].

Systems help the users to solve different problems with a new kind of view. These systems are storing, representing and organising all types of knowledge, including the rule-based and case-based approach, and other forms of knowledge [Liebowitz and Beckman 1998]. As disadvantage, there are some limitations of these systems, belonging to the model validation, reuse accuracy and compexity.

2.6. Neural Nets

Neural networks imitate the behaviour of the biological neurons of the brain, by using interconnected artificial neurons, which behaviour is modelled by mathematical rules [Sette and Boullart, 1996]. Neural networks are learning systems, but they have to trained by examples before the first use, and weighten factors are adapted.

These systems are fault tolerant, thereby the knowledge is distributed inside the whole system. Neural networks ensure well behaviour even with noisy and incomplete inputs. As disadvantage, these systems are highly depending on the computing capacity and the teaching inputs, and the problem solving capacity is limited to a specific, premodelled, preteached domain. These systems became very popular in different areas [eg. Yuan and Niemann, 2001; Braines and Cant, 2001; Hafner et al, 2000].

2.7. Analysis of KMSS

The general disadvantage of the most knowledge management support system, its dependency on the human co-workers. These systems are unable to handle the changes of the environment, generally, the stored knowledge is representing only a specific period of the time, statically. The role of the human knowledge workers is the maintenance, and periodically verifying content of the stored knowledge. These systems can represent the knowledge of expert employees, after they have left the organisation, but this knowledge base is remaining static [Hendriks and Vriens, 1999; Fowler, 2000].

Figure 2 presents the comparison of these systems. One of the observed dimensions is the support level of the human practices. The top of this dimension is the ream artificial intelligence, which can think and act without human help and supervision. The other dimension is representing the complexity-maturity of these systems. As compare, Hoffman and Patton, as well as Syed has examined the classification of KBSS [Syed, 1998; Hoffmann and Patton, 1996]

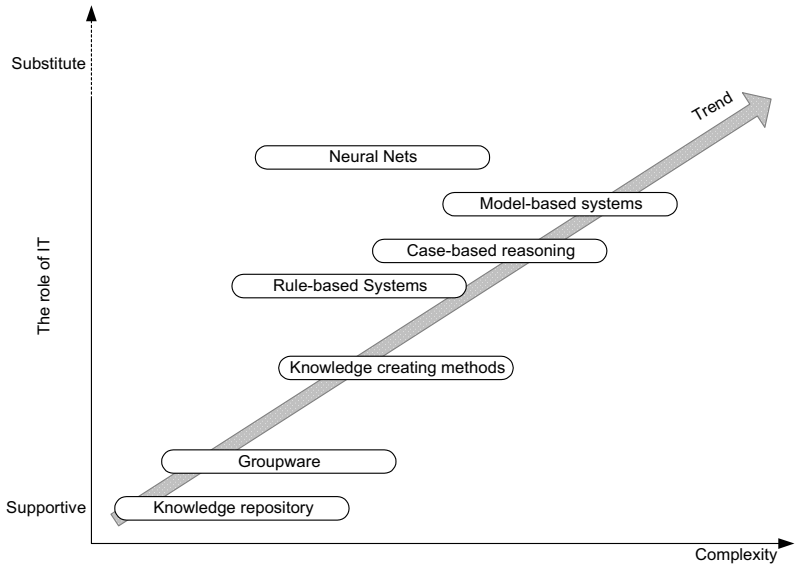

Figure 2: The comparison of KMSS in two dimensions

3. TOWARDS THE INTEGRATED FRAMEWORK

The field of Knowledge Management has the maturity to turn to integration approaches, there are already some significant works focusing on each part of this philosophy.

Many authors examined the relation between knowledge management and IT solutions [ex. Syed, 1998; Merlyn and Välikangas, 1998; Rao and Sprague, 1998; Junnarkar and Brown, 1997]. Fowler analysed the role of AI solutions in knowledge management processes, especially related to the human side of these practices [Fowler, 1999]. Liebowitz argues, that expert systems are the integral and integration part of KM practice [Liebowitz, 1998].

Hendriks and Vriens examined the role of the knowledge-based systems in organisations, and argued the advantages and disadvantages of these systems. A three-step methodology was developed in order to support the settlement of the knowledge-based systems inside the organisational knowledge management practice. The first step is the diagnosis of the assessment of the functionality of knowledge-based systems. In the development phase, design and implementation questions of KBS are examined. The last phase is the assessment and evaluation of the possible changes, occurred by the implementation of KBS. [Hendriks and Vriens, 1999; Hendriks, 1999]

Lai and Chu analysed the frameworks of several authors, and proposed an integral knowledge management practice process [Lai and Chu, 2000]. Rubenstein-Montano et al also analysed the existent frameworks, and the authors have suggested the approach of system thinking, which means a wider view, during implementing knowledge management practices [Rubenstein-Montano et al, 2001]. Although there is initiative in several works [ex. Wielinga et al, 1997; Wiig et al, 1997; van der Spek and de Hoog, 1995; Wiig, 1995], the real connection of knowledge management, knowledge management support systems and the corporate strategy does not exists.

On the strength of using knowledge management practices in organisation, the integration of technologies, techniques and theories of knowledge management, as well as internal environment, and organisational and IT strategy is definitely necessary.

The recommendations and expectations of a complex integrated framework are the following:

- System thinking approach [Rubenstein-Montano et al, 2001];
- Measurement and assessment of KM efforts and KMSS;
- Objective handling of role of IT [Dougherty, 1999];
- Differentiation of handling different knowledge types;

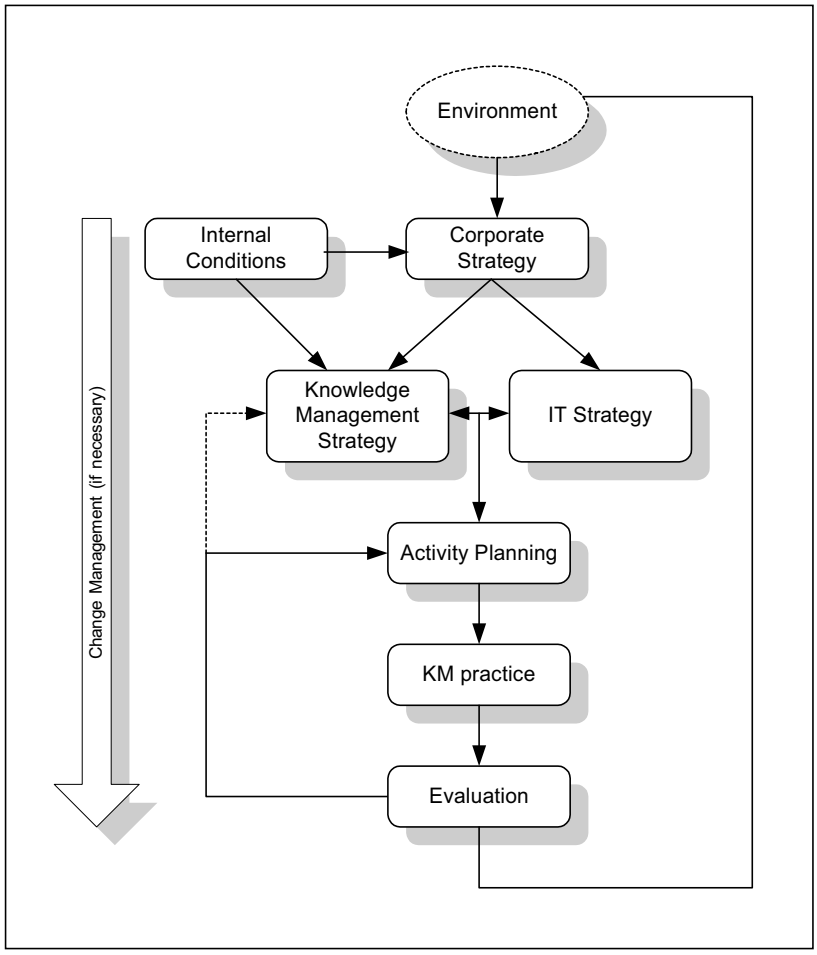

Figure 3: The organisational process of knowledge management

Figure 3 presents the process of creating and maintaining knowledge management practice inside an organisation. The basis is the organisational strategy – which is related to the environment and to the internal conditions –, and the resources and the possibilities of the corporation. At this level the decision over a possible organisational structure modification (flat, spherical, team-based or network),

or BPR is required, because this decision has a bearing on the sub-strategies, and also on the organisational environment. The modification of the organisational structure might be the basis of an effective knowledge management practice, through wider system thinking approach.

Although, as mentioned, knowledge management is not equal to information technology, the use of technological possibilities is necessary in most of the time. Therefore the relation between knowledge management and IT strategy is highly important.

The KM strategy answers two basic questions:

- *What is the goal of the organisation: knowledge creation or knowledge leverage?*
- *What is the approach of knowledge: codification or personalisation [Hansen et al, 1999]?*

Knowledge codification is more IT related, more database and IT-application oriented. This approach helps more knowledge transfer rather than knowledge creation. The personalisation strategy is more human-oriented, useable for unique problems, and operates with non-technical tools and solutions. In this case, knowledge is shared by social contacts, and the role of the IT is lower. The answers and through these answers the KM strategy determines the use of the IT support.

In this phase, corporate goals and expectations are declared, as well as the weight, importance of the organisational domains. Through strategy construction, the processes of the enterprise are deeply reviewed, in order to assess the knowledge-content, knowledge intensity, and supportability opportunities. These processes are detailed documented with the explored relations, the nature of the used the knowledge owners and with currently used methods.

During the planning of latter activities, the organisational environment and culture can not be negotiated. In lot of cases, the organisational culture is not KM supporting, not learning oriented, therefore the handling of the changes through the whole process is serious for the success of the efforts.

Activity planning means the selection of tools and methods for supporting or creating the knowledge management activities in each domain of the organisation. There may be domains, where this practice is not necessary, in some areas only non-technological solutions are needed. In this paper the IT tools are examined. Table 1 presents the advantages, disadvantages, and usability of the different KMSS for different organisation domains and situations, for the selection of the most relevant solutions. There are several theories about the phases of knowledge management [Lai and Chu, 2000; Rubenstein-Montano et al, 2001], generally the following tasks are covering the activities: finding/elicitation, processing/organising, storing, transferring/communicating.

Knowledge management is not only a one-time effort, [Rubenstein-Montano, 2001] multiple feedback is needed, in order to assure the learning efforts of the organisation, and the creation of new knowledge. During the evaluation task, the results and efficiency of knowledge management practice is assessed [Ahmed et al, 1999]. In the case of imperfection and fault practice, or not the expected level of efficiency, the review of all or parts of the KM activities is required. There is the possibility, that KM goals or the strategy is not clearly defined, ambiguous, controversial, and this is the reason of the fault knowledge management activities. In this case the recreation of KM whole strategy is necessary.

With the change of the environment or the organisational possibilities, the corporate strategy is also changing. In these circumstances the overview of IT and KM strategy is required, because there is the danger, that the corporate strategy in inconsistent with these sub-strategies. This review is also necessary in order to improve the knowledge management practice by a radically new approach.

	Knowledge Repository	Discussion forums	Groupware	Knowledge Creating Techniques	Rule-based Systems	Case-based Reasoning	Model-based Systems	Neural Nets
Domain[1]	Ø	Ø	Ø	complex	complex	no model	complex	unstructured
Knowledge Size[2]	Ø	Ø	Ø	Ø	small	medium	big	big
Role of Expert[5]	input	answer	co-operate	no	rules	solutions	models	no
Complexity of knowledge	low	middle	Middle	middle-high	high	middle	high	middle
Static / Dynamic Knowledge	static	dynamic	Dynamic	static	static	dynamic	dynamic	dynamic
Tacit knowledge[3]	middle	middle	Middle	low	low	high	high	high
Finding/elicitation[4]	2	3	2	4	2	2	2	3
Processing/ Organising[4]	3	Ø	2	3	3	3	3	3
Storing[4]	3	Ø	2-3	2	3	4	3	4
Transferring/ Communicating[4]	2	5	4	Ø	2	2	2	2

Notes:
[1] The complexity and exploration of knowledge domain (structure, elements, relations)
[2] The deepness of knowledge, how detailed for a domain
[3] The possibility of representing tacit knowledge
[4] Assessed at 1 (poor) – 5 (excellent) scale
[5] The role of the knowledge-holder experts
Ø: null or not defined

Table 1: Assessment of different technological solutions

4. CONCLUSION AND FURTHER RESEARCH

This paper presented, that the knowledge management practices of organisations are very softly connected to the corporate strategy and IT strategy, and knowledge management is handled as a separated function. Most of the companies do not know the possibilities of technologies, especially IT, and mainly using the less complex solutions. The reason of this distance is the fear of using unknown, more complex and new technological solutions, and the utilisation of these technologies is mostly unique developed.

In this paper, an organisational model was presented about the relations of knowledge management to the corporate and IT strategy, and technological solutions. This model shows a wider, system thinking approach of applying KM solutions in organisation, to achieve the most efficiency, as possible. Using IT solutions is allowing the organisations to achieve higher productivity and efficiency, but the cognition of these technologies is also required. Therefore in this paper, the most relevant and useful KM support technologies were collected, analysed and assessed, in order to situate these in the context of the whole organisation.

In future development this framework can be applied for detting KM project boundaries, project scope, through placing the scope company or scope domain in a multi dimentsional cube (dimensions: technology/IT, organisational properties and business strategy), and applying the presented metrics for selection the most efficient KM tool.

The development of the “deeper” KMSS do not have the maturity to present as a market product – although several solutions are ready for this step –, and the development of unique systems are more expensive and longer for organisations. Beside the approach of knowledge management efforts must

be consider in a wider view, development and appearance as market products of the KMSS is also necessary.

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