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KNOWLEDGE MANAGEMENT AND ARTIFICIAL INTELLIGENCE

In a better and better informed world we may observe big changes; not only the modern computer-based technologies offer a more effective way of data processing but new opportunities are created for knowledge workers. The next century is even called "knowledge era" because the information technology evolves from data processing to knowledge processing. Information files and knowledge bases used by the modern information technology have to be stored, transformed, transferred and shared in very effective modes. If so, the new challenge of managing of knowledge resources seems to be very up-to-date and obvious. The goal of the paper is to introduce and discuss an essence of knowledge management technology, which is foreseen as a tool-set for supporting the still growing human knowledge. The chosen techniques from the artificial intelligence area are pointed out as an effective way of knowledge management.

1. INTRODUCTION

The modern world is changing faster and faster, becoming in some sense *Cyber Society*, where knowledge and artificial intelligence play essential roles in computer-based human activities. Data processing is still a necessary basis for supporting lower levels of management but knowledge processing (whatever it means) will be more significant in the coming years. The actual challenge is the evolution from data and information to knowledge and in such a context very urgent problems appear. The first one is: whether it is possible to manage knowledge at all? If knowledge, as a critical factor of the next century development, has to be regarded in economic aspects, then its management seems to be obvious. The second one concerns artificial intelligence's (AI) past and future roles in the knowledge management (KM). These two questions are crucial in the paper.

Researches into the field of knowledge management have been initiated in the current decade and some very interested collective findings have been formulated, e.g. techniques elaborated for measuring intellectual capital or innovation as the most important benefit of KM (Stewart 1994, Sveiby 1997,

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Amidon 1997). In Poland, the topic has just been initiated, (Gołuchowski 1998 and Laurent-Mercier 1998). In this paper we will focus on presentation of the essence of knowledge management (especially including its “infrastructure”) and then we will define the more or less recognized goals of AI in the area of knowledge economy stimulation. In other words, our aim is to formulate basic relationships between KM and AI.

The paper is organized as follows. Section 2 is thought as preface to the “knowledge management world” and a general idea of KM is presented. In section 3 we describe the future of management, stressing trends and architecture to be assumed in the next century. There is direct impact on KM, so research directions in the field are concerned in this section, too. In section 4 we recall the artificial intelligence understanding and the basic interrelations between artificial intelligence and knowledge management, stressing knowledge management technology goals. Section 5 presents some AI applications, which can be parts of the very useful platform for knowledge management. Finally, we present the summary of the paper stressing the basic aspects of the knowledge management process.

2. CONCEPTS OF KNOWLEDGE MANAGEMENT

Knowledge has been managed at least since the first human was able to learn and transfer the learned skill how to survive in the dangerous environment of other tribemates (after leaving the garden of Eden). It can be said that some aspects of knowledge management (KM) support almost every human activity, even though it is not called this way.

It is a common wisdom, that people and information are the two main critical resources being recognized as the most valuable in any kind of activities, not to mention running a business. But up to the 80's there was not an accent put on knowledge and KM as such. The emphasis on various leading factors (goals of management) in the science of management was changing during the time (they were for example: product, customer). An interesting historical overview on the main critical features involved with human activities can be found in D. Amidon's book (Amidon 1997). The increasing interest results generally from the emerging global economy and the technologies that create the opportunity to develop it. Global economy means no boundaries for business enterprises. It can enable extending business activity area, but also new problems arise to solve.

There exist many more detailed reasons, beyond existing in the new reality, and mentioned in various publications, for getting interested in knowledge and what indicates knowledge management (Skyrme 1997, Murray 1998, Piasta 1998). Here are enumerated some of the frequently listed reasons for a new management's trend:

- increasingly faster, more rapid and discontinuous changes that force any organization to search for new opportunities to meet coming challenges,
- expanding business activity over distance and time,
- management approaches such as “total quality management”, “business process reengineering” and similar activities have limited successes – they helped organizations only become more efficient at what they do, but did not help them find in the new requirements coming from global economy, from rapidly changing environment,
- almost unlimited knowledge assets different from land, labour and financial capital,
- the need for open access to knowledge resources,
- the need for reusability of knowledge resources ,
- bigger opportunity created by new technologies,
- continuous focus on quality of decision making and on responsiveness through rapid reorganization to meet new requirements.

There can be formulated three main driving forces from those presented above, that are changing the rules of business and national competitiveness:

- globalization,
- information and knowledge intensity,
- advanced technologies (networking and connectivity).

Even though knowledge has always been managed, at least implicitly, effective and active knowledge management requires many new perspectives and techniques and touches on almost all facets of an organization. To enter a short overview of knowledge management, it seems necessary to present some existing definitions of the main subject i.e. knowledge managing and important aspects of knowledge that have to be included in the knowledge management processes. The term “knowledge” has been given many interpretations throughout history. Two of the most popular interpretations are:

- knowledge as understanding – we have knowledge if we understand something,
- knowledge as information – we have knowledge if we have information in some form.

But knowledge as understanding and information omits what is essential to produce the results: action, the action that produce value (Dunham 1996), because raw information even in large quantities does not by itself solve business problems, produces value or enhances competitiveness (Murray 1998). In dynamic interpretation, knowledge is seen as information transformed into capabilities for effective action. The power of incorporating action into interpretation of knowledge is that it puts the focus on the action to be produced, not just on understanding or information that require another step to get to action.

For great emphasis on dynamical nature of knowledge, knowledge is defined also as information that changes something or somebody – either by becoming grounds for action, or by making an individual (or an institution) capable of different or more effective action.

In this context R. Miskie (Miskie 1996) defined KM as *a strategic approach, a way of thinking that produces an increase in one's capacity to take the action*. K. E. Sveiby (Sveiby 1998) presented an interesting point of view on knowledge aspects and knowledge management. He distinguishes knowledge as objects and knowledge as processes. Knowledge as object means knowledge sources of ability to produce products and services, the source of each company's capabilities. Knowledge is the foundation of human ability to compete in business because the future is based on the ability to accumulate and to effectively employ knowledge. (This type of knowledge can be seen also as a static property of knowledge and it is often called explicit knowledge.)

Knowledge as processes means assessing, changing and improving human skills or behaviour. This type of knowledge is a complex set of dynamic skills, know-how etc., that is constantly changing. (It may be called tacit knowledge.)

According to the introduced aspects of knowledge: object and processes, K. E. Sveiby (Sveiby 1998) defines KM as two tracks of knowledge management:

- management of information that is involved in construction of information management systems, artificial intelligence, groupware etc.; knowledge object can be identified and handled in information systems,
- management of people that are involved in learning and in managing competencies individually.

Knowledge can be perceived also as its usability to sustain in a rapidly changing environment, more precisely, that knowledge can deal with the changes. There are two types of changes, which result in two different types of knowledge. The first change involves the improvement of the existing system in an explicitly definable way. In this case we deal with explicit knowledge capturable and shareable in conventional communications forms (i.e. reports, presentations). This type of knowledge is concerned with improving what is already in place without creating or destroying its functions or processes. The second change involves creating new systems out of old ones. There we deal with creative change which entails implicit knowledge. This type of knowledge cannot be voluntarily recalled and articulated. The distinction between explicit knowledge which can be articulated in a formal language, hence can be transmitted among people, and tacit knowledge – personal knowledge embedded in individual experience and evolving such intangible factors as personal beliefs, perspectives, and values (Polanyi 1966, Sanchez et al. 1997) is a key premise underlying the assertion about the close connection between

knowledge and action. But the basic problem is that tacit knowledge is rarely recorded and shared in business organizations, even though tacit knowledge may be a real key to getting things done.

Finishing the consideration of some possible understanding of the term knowledge we may state two things. Firstly, there have been introduced some properties or aspects of knowledge that do not close the possible perception of such ambiguous knowledge concept (Schmid 1989). Secondly, knowledge concept can have many aspects. Thus knowledge management has to face all of these to cover most of them.

It should not be omitted that like most assets knowledge is only valuable if it can be transmuted in goods and services that people will pay for (Skyrme 1997). Knowledge unlike information is less tangible and depends on human cognition and awareness. Knowledge is largely cognitive and highly personal. Thus measuring the knowledge asset means putting value on people, both as individuals or more importantly on their collective capability, and other factors such as the embedded intelligence in an organization's computer systems. There are some approaches trying to solve the measurement problems (i.e.: Owoc 1998, Stewart 1995, Strassmann 1996 and Sveiby 1997). It can be said that they are generally aimed at better understanding of the contribution of knowledge to business success.

As can be seen, a knowledge concept is difficult to define in an unambiguous way. It was also shown in examples how it may influence the definition of knowledge management. Very similar problems occur while trying to state what knowledge management is. Knowledge management's movement is cross disciplinary (management science, organization science, computer science, artificial intelligence and so on), thus it can be one of the reasons for some differences in stating this term. The diversity of stating the knowledge management results also from different expectations which are to be met. Keeping in mind that the goal of each kind of management is to establish and to execute a process which is intending to achieve expected goals goes through the proposition of KM.

The first definition determines the boundaries of knowledge management activity (processes) without any specification as to what these activities are and it is as follows:

Knowledge management is the framework (to capture) within which the organization views all its processes as knowledge processes.

In this view, it can be assumed that all business processes involve creation, dissemination, renewal, and application of knowledge toward organizational sustenance and survival are included.

The goal of knowledge management is expressed by P. C. Murray (Murray 1998). According to him:

Knowledge management is a strategy that turns an organization's intellectual assets – both recorded information and the talent of its members – into greater productivity, new value, and increased competitiveness.

As the author explains this concept, KM teaches corporations (from managers to employees) how to produce and optimize skills as a collective entity (Murray 1998).

Often the author's profession has the main influence. The next case presents this: *KM is the strategic process of managing all aspects of knowledge acquisition, development, organization, use, and distribution.*

This statement reflects the technological point of view, distinguishing processes which can be attended by old and new technologies.

There is one more definition aimed at the knowledge processes management with the clear goal to technological aspects of KM. This definition was introduced by J. Angus, J. Patel, J. Harty (Angus et al. 1998) as:

Knowledge management is the name of a relatively new concept in which an enterprise consciously and comprehensively gathers, organizes, shares and analyses its knowledge to further its aims.

The authors specify also lists of activities involved in each of the mentioned knowledge processes.

The KM concept evolved to outline some aspects of desired activity included within. For example Y. Malhotra (Malhotra 1997) defines KM as follows:

KM caters to the critical issues of organizational adaptation, survival and competence in face of increasingly discontinuous environmental change. Essentially, it embodies organizational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings.

And the next KM statement by Malhotra (Malhotra 1998) sounds as follows:

KM is a knowledge-based view of the organization's business processes for leveraging the information processing capacity of advanced information and communication technologies via translation of information into action by means of the creativity and innovation of humans to affect organizational competence and survival in an increasingly unpredictable (hyperturbulent) competitive environment.

The last definition expands the earlier statement and puts an accent on the "knowledge-based" view to outline a different kind of management and another subject to manage, which is not visible in the first statement. Malhotra's definition considers the synergy between "technological" and "human" (behavioural) issues as the main necessary factors for survival. The authors of this paper broadly accept this aspect of KM definition. In our opinion the need for the synergy of technological and human capabilities is very important and it is based on the distinction between the old and new business era, between information and knowledge era. There can be seen a necessity to develop more

directed by KM's needs for artificial intelligence technology. Because KM is a rapidly developing and expanding field, the changes in stating KM will naturally continue. Despite the knowledge management definitions differ in some aspects, there can be stated some necessary directions facing knowledge management to meet old expectations in the new business environment.

3. MANAGEMENT TRENDS AND ARCHITECTURE

The traditional business model (i.e. hierarchical organization) no longer fits business requirements. In fact, an organization must be continuously redefined to meet the rapidly changing environment. Hence all organizations become more dependent on their use of knowledge as strategic resources for organizational survival and competence in the new world of business (global economy). The new focus on knowledge forces a shift from information era to knowledge era. Information era considers technological systems as key components guiding the organization business processes, while treating the humans as relatively passive processors that implement "best practices" stored in information databases. In contrast, the knowledge era treats human systems as key components that engage in continuous assessment of information archived in the technological systems. The necessary changes are so radical, that it can be said that enabling the effective uses of knowledge are characterized as "re-everything".

The focus put on humans indicates more attention aimed at man's ability that can be supported and used in any enterprises. In this context man's most important feature is his learning ability. Education is becoming the most important factor garnering development of all organizations: industrial, research and service. Education is becoming to be treated as an investment, not an expense. The traditional model of learning master/apprentice does not meet the new expectations. The process of creating and using knowledge is more important than knowledge accumulation. Active learning must occur real-time in structured or informal ways.

The traditional hierarchical organization, which was good enough to meet industrial era expectations, cannot serve the knowledge era. It is too stiff to be able to handle the whole organization's intellectual capability. Flexible organizations forms that give the opportunity to more effective and modern functioning of organization are much more adequate. There are already two new organizational forms: Strategic Business Network and Strategic Business System, which are based on network technologies. These approaches can cover the whole organization, as they can pass organization boundaries to customers, as well as business competitors and research laboratories.

In the world of an emerging global economy, business expands the definition of potential business enterprise. It indicates, among other things, a great accelerating in communication technology. There is no opportunity to easily survive without an integral relationship with partners, suppliers and other stockholders. No enterprise, if it is to bring a profit, can be limited only to organization on a local or national level. There is a need for global approach without any boundaries. In the knowledge era there is no place for local strategy, but it should be expanded to international strategies. Creating international strategies brings new problems involved with understanding and cognition of different cultures. Disappearing cultural differences and keeping competence in balance are becoming the only way to survive. Such an approach requires a collaborative rather than competitive strategy.

In an information era there dominate the win/lose competitive strategies, which should be shifted to collaborative strategies. This is the most difficult problem to be solved, because even co-operating community members divide profits creating such strategies. In our opinion this requires changing human nature – this is a real challenge. The main goal shift is creating the opportunity for the common use of collaborative strategies. This is limited to bring common access to whole (accumulated) garnered knowledge. The advantages of such an approach are obvious but there should be pointed out the more general message – to achieve an equal standard of living of all the world's communities. Realization of the knowledge management process has to be done in some structured manner. In Figure 1 the basic components of the KM architecture are presented (Amidon 1997).

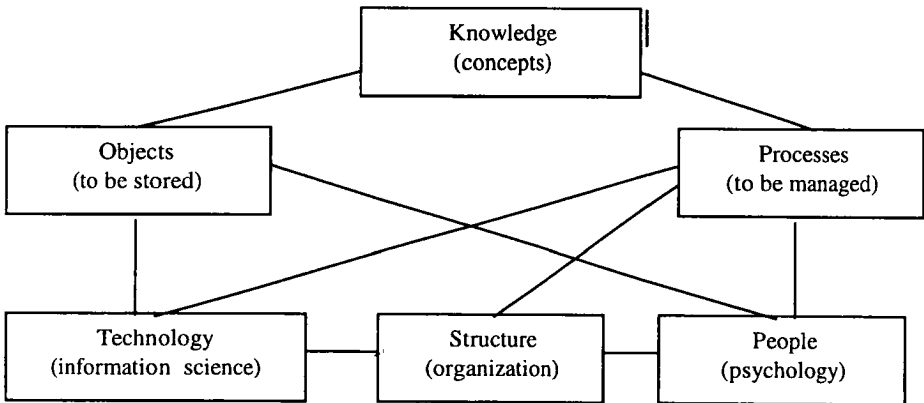


Fig. 1. Knowledge management architecture
Source: Amidon 1997, p. 71.

The starting point of the architecture is knowledge definition presented in the previous section, hence two aspects are taken into account: knowledge as an object

and as a process. The crucial components of KM are **people** (which indicate sense of purpose, learning philosophy, role responsibilities), **structure** (covering systems dynamics, staffing patterns and collaborative strategy) and **technology** (representing intelligence system, network management tools and the like). Such an understanding creates in some way a platform for keeping KM as a system in balance.

4. ROLES OF ARTIFICIAL INTELLIGENCE IN KNOWLEDGE MANAGEMENT

Though the idea of an intelligent machine was known ages ago, the era of artificial intelligence (AI) as a separate scientific domain, started with an IBM summer workshop in the 50's at Dartmouth College. Despite AI being rather an intimidating term there are many definitions of AI. Let us quote the more representative of them.

Some of the authors stress the act of studying and its topic, for example according to E. Charniak (Charniak et al. 1985, p.6): *"AI is the study of mental faculties through the use of computational models"*.

A similar understanding of AI is represented in (Durkin 1994, p.3): *"AI is a field of study in computer science that pursues the goals of making a computer reason in a manner similar to humans"*.

It was obvious, from the very beginning, that AI differs from other studies offering the new feature of a computer – some ways of tasks performing which employ stored domain knowledge and reasoning as two necessary components.

Nowadays AI, after many years of experience, can be recognized in a broader sense, with a theory and practice of its own. We assume (Murray, 1998), that: *AI is the multi-disciplinary field encompassing chosen scientific areas (e.g.: computer science, philosophy, robotics and linguistics) aimed at reproduction of the methods of human reasoning.*

As was mentioned earlier, one of the most important focuses of AI is knowledge, which can be represented and used with adequate technology means. In practice, AI represents specific ways of data processing, therefore the term "artificial intelligence technology" is widely spread. Relationships between knowledge management and artificial intelligence are very strong and there is an impact on developing both of them. Knowledge management needs technology for performing typical functions belonging to the process. Most of these tasks can be directly served by artificial intelligence technology. On the other hand, any processes oriented on knowledge are subjects of AI, hence knowledge management became the new challenge and important enough in the AI community and bore a conference of its own (Meltsner, 1997 and Heijst, 1997).

Let us regard the past and actual roles of AI as the information technology with a KM context.

Taking into account the applications of AI in different areas, we think about knowledge based management systems. Traditionally, these tools are able to support the following functions:

- knowledge acquisition, where such tasks as identifying possible information resources and transforming them into knowledge are performed,
- knowledge representation, where the chosen domain knowledge is stored in an effective way to secure accurate access and reasoning,
- knowledge management, where the rest of the tasks necessary for keeping knowledge up-to-date and its utilization for different problem-solving purposes are offered.

At least, the latter function (even by name) can be observed as strictly referring to the general concepts of KM. But management has to be regarded in the more global perspective.

As was stressed in the previous section, we may expect evolution in business management, which is oriented to customers and the market economy. In such settings customers can be recognized as a source of knowledge and three distinct models are developed (Goldman et al. 1995): sales, relationship and partnership. In some circumstances, the **Sales Model** – a data-intensive, using product-push strategy and data-based management seems to be effective. It can be applied to provide base services to actual customers, where traditional interaction and product as capital may be recognised as an ultimate value. The more advantageous is the **Relationship Model** built on the concept of value-added for the customer. The strategy becomes market-pull with information-based management. The model can be introduced when total quality program has been designed to promote customer satisfaction; in such conditions interaction has to be planned and finance as capital plays the essential role as value. The **Partnership Model** looks the most promising for future. The basic strategy can be labelled as balanced product/market and management is knowledge-based. In this case, interaction and communication are the most advanced: they may be recognized as symbiotic and network learning respectively and the final value of this approach is knowledge as capital.

The presented evolution of the models can be established as a base for pointing out parallel directions of researches on AI and KM. In general, let us recall the goals of AI, which are promising for KM areas. The AI roles in this respect can be formulated as follows:

- the theory of computer-based solving problems has been formulated (and still developed) in the form of: search techniques, memory organization and

deduction, automatic programming, language comprehension, machine learning and the like,

- the methodology of AI application development has been proposed; it includes: knowledge-based system life cycle, knowledge acquisition techniques, knowledge representation methods, knowledge validation procedures,
- the tools supporting knowledge-based system development have been proposed: expert system shells, specialized programming languages, neural networks, genetic algorithms and case-based reasoning.

AI as the scientific discipline enforces more and more effective co-operation of knowledge-based management system components: implementation of reasoning strategies, communication means (natural language processing, open systems, global area networking), adaptive systems (machine learning), corporate strategies and systems (robotics, integrated solutions etc.).

This is obvious, from this overview, that AI technology plays the crucial role in KM. Some of the aspects expected from the information technology features are available in AI environments (knowledge-based management, network learning). Therefore, the basic components of knowledge management technology (KMT) are derived from the AI areas, the others play supporting roles. KMT includes the following components (Murray 1998):

- Database technologies, as a classical way of processing huge data files – the basic role in KMT is delivering “raw” data structures, which are the potential sources of knowledge,
- Document Management, which serves online access to documents stored as independent files, for example as bit-mapped images or more compound objects including multimedia,
- Computer-Supported Collaborative Work/Groupware, that supports communication and teamwork to store concepts, discuss them and to rank solutions of the problems,
- Distributed and Open Hypertext Systems, which offer access to any files stored in the global worldwide network; the needed information can be retrieved and links of marked points can be tested,
- Geographic Information Systems, that from their nature can play the similar role, namely can be used as “manipulators” of corporate data on the digitized maps,
- Intranets, that can be used in conjunction with Internet browsers as a user platform to view and process organization’s information from classical relational databases as well as unstructured texts,
- Help Desk technology, a relatively new category of products, that provides intelligent service for different users; it can be worked effectively as some kind of customization of separate working managers,

- Knowledge representation, which takes many forms making possible knowledge processing for computerized tools; examples of knowledge representation techniques cover: concept mapping, semantic networks, information modelling, hypertext systems and many others,

- Knowledge sharing, that arises from the challenge signalled earlier – though there is a natural tendency for information and knowledge capturing – the future and progress of civilization depends on the collaboration of knowledge centres. Applying more open approach, humans can achieve a higher level of development as a result of knowledge sharing.

All itemized components can be grouped according to their basic roles for fulfilment in KMT. Therefore, three viewpoints of knowledge management seem to be the most important. They are pictured in Figure 2.

The first aspect, marked as knowledge **accumulating**, is in some way a preparation stage for knowledge management. The technologies useful for knowledge acquisition: databases, document management (including EDI – Electronic Data Interchange) and knowledge-based technology can be essential. The second group gathers facilities for knowledge **creating**. This respect refers to the KM components, which allow for a generation of computer accepted coded knowledge. This reference supports users working as individuals in their tasks (knowledge transformation and finally knowledge augmentation automatically). The last aspect of KM covers different modes of knowledge distribution – we call it

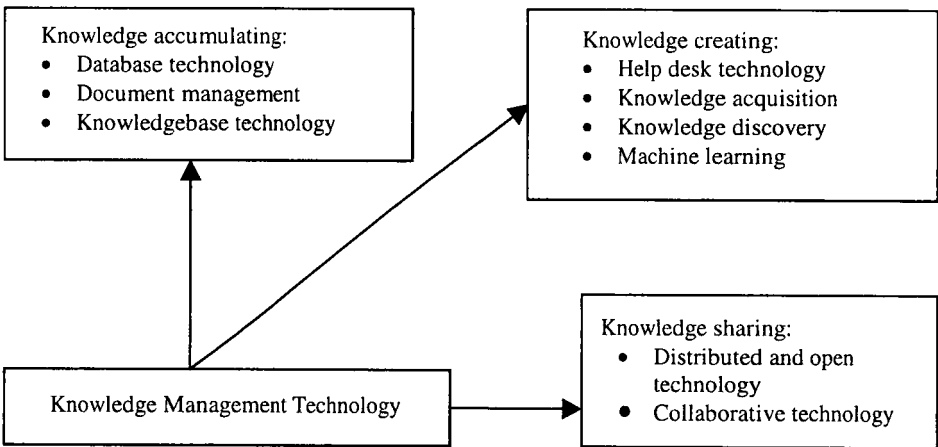


Fig.2. Knowledge management technology aspects
Source: own research.

knowledge **sharing**. One of the crucial management trends arises from more global understanding of making business. Therefore, KMT components have to

be oriented more on collaborative work – the groupware solutions working in computer networks become very useful.

5. CHOSEN KNOWLEDGE MANAGEMENT APPLICATIONS

The KM process, defined in the previous sections, can be (at least partially) supported by applications using artificial intelligence technology. To be precise, AI and its practical results elaborated hardware and software infrastructure for performing an idea of computerised management of knowledge. Let us recall the typical tasks of KM (Murray 1998). They are:

- Converting personal knowledge into shared knowledge resources,
- Understanding and learning (acquiring or extracting knowledge value),
- Enabling action through knowledge (performance and management),
- Processing shared knowledge resources,
- Delivering (transferring) explicit knowledge,
- Building a technical infrastructure.

In practice, not all of the mentioned tasks can be effectively supported by invented AI applications. Some of the processes are out of interests for many reasons. Existing knowledge tools can be divided into the classes, which are prepared for KM (compare: Ruggles, 1996):

- Knowledge generation tools – they include the first two aspects of KM: accumulating and creating,
- Knowledge codification tools – they support the final form of a knowledge base to be stored covering knowledge typologies, creating links to knowledge pieces and the like,
- Knowledge transfer tools – they serve the other activities, not mentioned above, such as: “temporal distance”, “social distance” or “relationship mapping” for translating and keeping on site purposes.

Broadly speaking, the itemized tools are technologies, which enhance and enable chosen tasks of knowledge management. Let us have a look at some applications from the domain (Murray, 1998 and Ruggles, 1996).

WINCITE KM software has been developed for collecting, organizing and accessing business intelligence from many sources of knowledge. The Internet facilities are engaged in information gathering. There are three main functions served by the product: mapping a wide range resources, classifying them, and providing multiple views of the knowledge base. These multiple views are achieved by using structured methods of representing the different characteristics of knowledge resources e.g. applying classification codes, sales volumes or geographic market areas. The main advantages of the tool are: direct approach to KM and easy populating the customized information reports.

Cogito product represents organizational knowledge as some kind of an internal network of concepts and relationships in the form of a network database derived from source documents. Many links created on the documents allow for a fast and effective mode of processing informational resources. The information elements get unique identifiers for managing semantic networks and this solution is the strong side of the software.

GrapeVINE is offered as the best solution for institutions using the Lotus Notes environment. The product is classified as the generator knowledge tool, though building the knowledge base takes time. A general idea of the package is pulling information from different external databases and distributing it to users through the Notes messaging system.

KnowledgeX solution can be applied in competition-like environments to track career paths. There are some problems of delivering explanations to information to be acquired from the SQL databases. Although the tool seems to be easy to install, some difficulties with populating results are a disadvantage.

Examples of KM applications confirm rather the partial supporting of the management process. However the market of these products is promising and thousands of corporations are engaged in creating better leverage of their knowledge resources.

6. CONCLUSIONS

Knowledge management and artificial intelligence are two theoretical and practical in use areas crossing themselves. The need for managing the still growing and more and more distributed human knowledge requires very sophisticated approaches, which are domains of artificial intelligence. To summarize the paper issues, we have to underline the main points of KM essential in coming years.

The first one covers the necessary steps to create a proper environment of the KM processes. They include (Skyrme 1997a):

- opening companies themselves for more global activities; they will identify how their knowledge assets can be recombined to create new knowledge-based businesses. To put an example: an engineering/manufacturing company might create an engineering consultancy business;
- creating "knowledge management centres"; many organizations are now realising the opportunities for trading their databases or knowledge bases. It denotes new opportunities for sharing knowledge and crossing out institutional barriers and switching from knowledge communities to knowledge markets;
- recognizing knowledge processes as knowledge objects; this means applications of the object-oriented approach, where knowledge can be

processed as objects with all consequences, for example: encapsulation and inheritance as object methods. In other words, the contents of such packages can consist of information records or multimedia clips, and access to a person, that can be manipulated and transmitted in different ways.

- more active knowledge processing; consists of shifting from knowledge maps to knowledge navigators/agents. Maps are static representations of objects, and without extensive real time map making capability (which could happen in the future) we need other ways to find existing and emerging knowledge to process it more dynamically e.g. using intelligent software agents,

All the itemized components of KM have to be integrated as one consistent technology. Therefore the second point refers to the integration aspect of KM. Objectives of integration can be expressed, as (Abecker et al. 1997):

- integration of different kinds of information systems (e.g. data warehouses, workflow systems, document management systems, etc.),
- integration of different kinds of knowledge (e.g. knowledge of the organizational structure, of the business rules and the like),
- integration of knowledge whose degree of formalization is different (e.g. textual representation of the business rules and its formal representation in a knowledge-based system).

A central knowledge repository can be created and maintained when all the integration objectives have been achieved.

As a result, knowledge management may create better passing to knowledge innovation. It can be achieved as a collaborative supported by efficient artificial technology as ENTOVATION International Centre (Amidon 1998). It can create a basis for knowledge management as a separate scientific discipline.

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