THE ROLE OF KNOWLEDGE CONTAINERS AND KNOWLEDGE MAPS IN CREATING AND SHARING KNOWLEDGE*

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Knowledge creation and sharing should be understood in the framework of the knowledge life cycle containing the demand and supply side. Knowledge production is not possible without appropriate knowledge claim from the future user. The sources of knowledge, tacit and explicit, are knowledge containers. These containers are made up of living agents (individuals and groups) and non-living artifacts which are frequently artistic. These artifacts are important in knowledge transfer from one generation to another in a longer time horizon. Knowledge transferred in this way is often impenetrable or incorrectly interpreted. Knowledge maps, consisting of carrier, text and graphical symbols, make it possible to use the knowledge which is stored in the knowledge containers. This paper deals with knowledge containers and knowledge maps and their position in the knowledge life cycle. It is the view of the authors that a knowledge map represents the connection between the demand and supply side of the knowledge life cycle.

knowledge management; knowledge life cycle; demand and supply side; knowledge container; knowledge map

INTRODUCTION

The main goals of the knowledge management (hereafter only KM) are integration of various sources of knowledge into a knowledge base of organization, support of learning and knowledge sharing throughout organization, for individuals and teams. This view of KM we call "first generation of KM". The historical development proved that the KM is not only a technical process of storing, codifying and upgrading knowledge. The process of acquiring and using knowledge in organizations should be understood as a cycle, called "knowledge life cycle" (hereafter only KLC). The KLC includes both knowledge entities and mutually connected processes.

The history of KM as an independent discipline began in the 1990s and quite a lot of theories have been published since then.

According to Gorelick et al. (2004) there are four phases of the KM development:

Phase 1: Information support for decision making (formulated before 1995)

The focus of information technologies was typical for this phase. But discrepancies between the output of the information systems and the needs of the real processes in the organizations have been progressively identified and it thus became clear that classical information systems were not sufficient to fulfill KM requirements.

Technicians concentrated mainly on the capacity and function of the information systems and interfaces which conveyed only pre-defined solutions to the user as mentioned in McElroy (2003).

Phase 2: Tacit and explicit knowledge (formulated after 1995)

In Nonaka, Takeuchi (1995) were introduced the terms tacit and explicit knowledge. The Nonaka's SECI model dealt with the possible conversion of tacit knowledge into explicit and vice-versa (see Fig. 1). Explicit knowledge has been realized in artifacts, such as text, speech, picture and video. This kind of knowledge can be easily stored and used repeatedly. Sharing of this knowledge among individuals and teams is easier and allows the use of existing information and communication technologies.

Tacit knowledge is primarily in the heads of people. It contains their personal experience, feelings and skills. The social status of a person is also very important. Sharing tacit knowledge is more difficult and special methods connected with personal interaction of human being must be implemented.

The recommended methods, according to Krogh et al. (2000), are:

⇒ Direct observation
⇒ Observation with explanation
⇒ Imitation
⇒ Experiments and comparison

Phase 3: The use of a narrative (formulated after 2000)

The phase 3 and 4 are called by McElroy (2003) the "second generation of KM".

The main principle of this phase is moving from "knowing" to "saying" and/or "writing". This change may of course imply an important loss or distortion of knowledge. It is also called "the phase of stories" and focuses on the power of telling stories or conversation in knowledge

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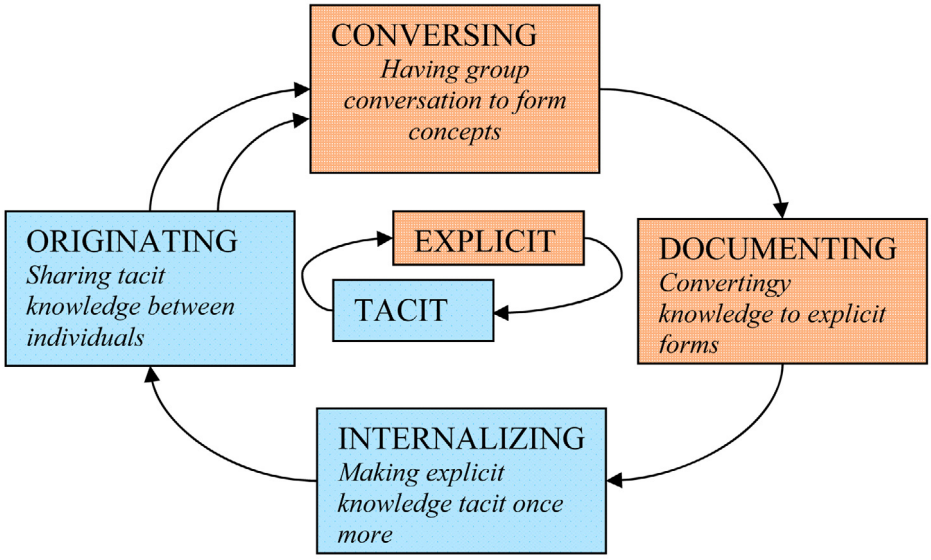

Fig. 1. Interaction in a knowledge spiral – according to K r o g h et al. (2000)

sharing. The ability to narrate thus became an important managerial skill. It is important in understanding a specific situation as well as the personal situation of the actors involved. The ability to speak (or write in) various languages, to translate and interpret are very important in this context.

Phase 4: The integrated knowledge management framework

Phases 1, 2, and 3 may be seen as building blocks for an integrated model of KM. The fourth phase synthesizes the components introduced in the previous three phases. The shift from copying and distributing knowledge to problem solving and to the introduction of new methods is of crucial importance in KM.

The definition of the second generation of KM, according to M c E l r o y (2003), is as follows:

KM is a framework for applying structures and processes at the individual, group, team, and organizational levels so that the organization can learn from what it knows to create value for its customers and communities. The KM framework integrates people, processes, and technology to ensure performance and learning for sustainable growth.

A practical example of this different approach is that within KM frameworks knowledge flows of an organization and the focus on organizational learning become closely related.

The first generation of KM concentrated on the supply side, whilst the second generation took into account also the "demand" side of the KLC. The "demand" side is based of human social activities which lead to new *knowledge production*.

Knowledge on the "supply" side is codified in some way, in databases, texts, practical exercises, environmental studies or knowledge maps. The task of the "supply" side is to put existing knowledge into practice, i.e. *knowledge integration* (see Fig. 2).

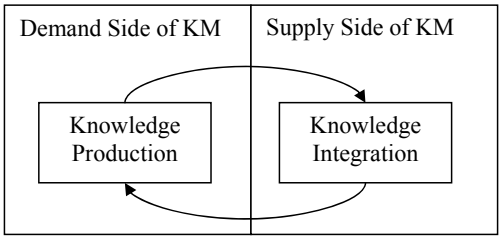

Fig. 2. Demand and supply side of the KLC

The existing knowledge of organizations (see Fig. 3) is stored in knowledge containers. A knowledge container is understood to be an object, a living person, who possesses knowledge (as well as information and data).

Knowledge maps are used for interpreting and sharing knowledge. A knowledge map is a graphical representation of knowledge, in two or three-dimensional space.

MATERIAL AND METHODS

The purpose of this article is to characterize knowledge containers and knowledge maps as important conceptual parts of the KLC, specifically within the second generation of KM. The relations between knowledge maps and knowledge containers will be described mainly from the point of view of problem solving as well as the necessary implementation of dynamics in static structures.

The methodology will be based on the analysis of features and functions of knowledge maps and knowledge containers. Their relation will be defined with respect to the practical use for problem solving and to the use of existing knowledge in an organization.

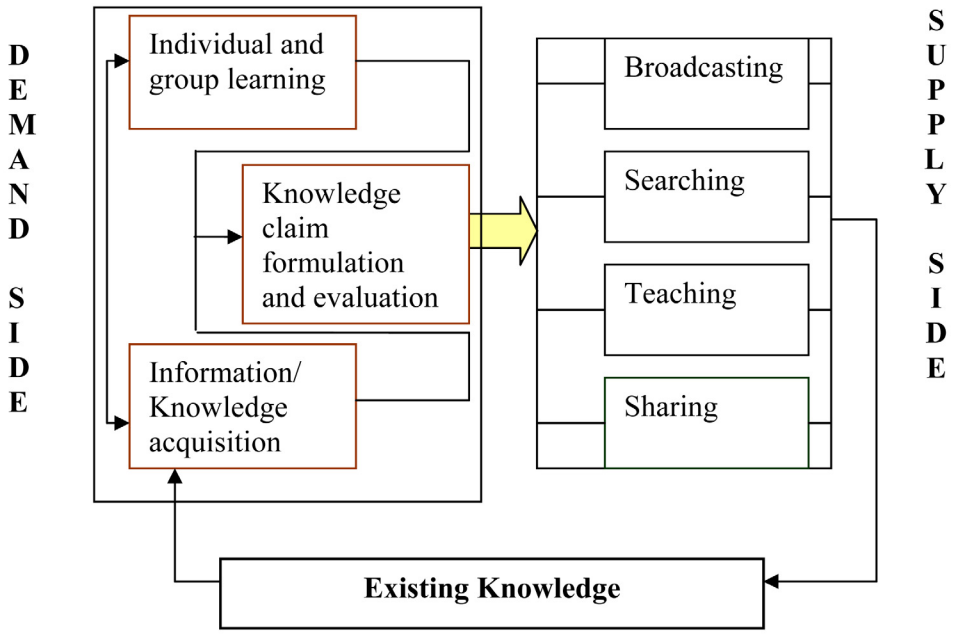

Fig. 3. KLC according to McElroy (2003)

RESULTS

Knowledge life cycle

The KLC (Fig. 3) is a conception which integrates knowledge production and sharing into human social systems. Until now most practitioners have concentrated on the "supply" side of the KLC. Of course the "demand" side is crucial for knowledge production. Knowledge cannot come into existence without a knowledge claim. A knowledge claim includes the ability and willingness to learn, i.e. to actively acquire knowledge.

There is here an analogy between the term "aggregate demand" used in economic theories. This demand represents not only the "willingness to buy" certain product, but the "ability to dispose" of an appropriate sum of money.

To express this knowledge claim in a concise and proper manner is often very difficult. Well formulated, relevant questions are an important prerequisite for solving a problem.

The formulation of the knowledge claims corresponds with the first phase of decision making according to Simon (1960). This phase is called "intelligence phase". It is the most difficult step in the decision making process and is of crucial importance for solving a problem. In this phase the problem can be formulated and described in the following way:

The term "Existing knowledge", as illustrated in Fig. 3, represents all distributed and integrated knowledge of an organization, both tacit and explicit. The supply side of KLC can convey the internal knowledge of an organization, as well as knowledge coming from external sources.

The integrated knowledge of an organization may be stored in various forms, not only in databases and data files in informational systems. The most important prerequisite is that the workers are able to find the knowledge and use it. This means that an organization "knows what it knows" has a total command over the stored knowledge and knows where and how it can be found, retrieved and utilized.

Example: In our university there is one central library as well as libraries belonging to various departments. The list of books located at the departments is of course available in the central library and the books may be borrowed, subject to certain regulations. The knowledge in all these books is the integrated knowledge of the organization (i.e. the university). The books are not stored in one place but they are accessible. Information about the exact location of each book is also available.

The distributed knowledge of an organization usually exists in the heads of the staff members (tacit knowledge). Private knowledge sources of individuals or teams, which are not accessible for others, and information about their existence, which has not yet been shared, belongs to the category of distributed knowledge of an organization.

The existing knowledge of the organization is stored in knowledge containers. Knowledge containers often contain knowledge which is not organized and codified in an appropriate way.

The individual knowledge claim rises from detecting the difference of the present and desired status of their knowledge. This difference is called "*knowledge gap*" – see Beránková, Dömeová (2006). This gap can be detected also by artificial methods, i.e. tests and examinations. The knowledge claim is also formulated during the learning process and in discussions with other team members.

The process of learning is started if a knowledge claim is formulated (question), the appropriate knowledge is delivered (answer) and the ability and willingness to learn (motivation) exists.

During the process of learning new knowledge claims are formulated because the person discovers what else he/she needs to know. The learning process if often collective; the new knowledge claims also derive from interpersonal communication.

The knowledge claim formulation, with the aim of knowledge production for the user, is a part of the demand side of the KLC.

Another part of the demand side is the *knowledge claim evaluation*. Not each knowledge claim is the line with the interests and goals of the organization. The managers evaluate which knowledge claim should be provided to which groups of workers. The evaluation process can be realized in several levels.

Integration of knowledge, its distribution to chosen individuals or groups, its mediation and sharing, these are the main tasks of the supply side of KLC. The important role of a manager (or knowledge professional) is to also transfer knowledge to subjects who have not placed an explicit knowledge claim, yet for whom certain aspects of knowledge are a necessity, which is in line with the goals of an organization. Example: One employee asked how to use certain functions of the ICT system. The manager mediated the answer and also reminded other employees that this function exists, is useful for certain tasks and explained its use. This situation, when one person searches for an answer and others suddenly discover, that they also need the very same answer, is very frequent. It is also reasonable to prepare staff members, who have not done some work in advance, to use knowledge claims from the past. Experts are also able to predict some problems and prepare answers for questions, which may be expected to arise in the future (e.g. "Frequently Asked Questions" sections, which are quite popular in many contexts. In fact these are reactions for *supposed knowledge claims*).

Knowledge containers

Knowledge containers (hereafter KC) contain two kinds of knowledge (Fig. 4): tacit and explicit. Tacit knowledge is held by individual living persons and/or related groups of individuals – *agents*. Explicit knowledge is stored in various forms of *artifacts*. Artifacts can be documents, computer records and programs, pictures, plans, products, but also paintings, sculptures, music composition, such as records or scores, collection of historical subject or products of nature.

The role of KC is to preserve knowledge and to reflect knowledge claims. Previously formulated knowledge claims and appropriate answers, as well as outputs of business processes of an organization and outputs of knowledge processing, are also stored in KC.

Agents may not only act as independent knowledge sources, but also act in synergy with artifacts. They can, for example, explain technical details, applied methods of work and their experience. Agents should be able to communicate, discuss and teach.

Knowledge containers are a base for discovering and mapping knowledge to McElroy (2003). Knowledge maps include knowledge and information, both from agents as well as from artifacts.

Knowledge maps

A knowledge map (hereafter KM), according to Havlíček, Pelikán (2007), is a synthesis of various conveyors, graphical symbols (topology) and texts. A conveyor is a part of a two-dimensional or three-dimensional space. A conveyor may be formalized within a system of coordinates or by other tools. The topology of the KM is represented by various geometrical signs, pictures, icons, arrows, connecting lines, irregular formations. Topology is formalized if it is composed of elements which are part of the graph theory.

The KM is not a description of the KC, but it is an indicator, showing to usage of the KC in solving problems. The KM usually does not contain domain knowledge. Detail descriptions, longer text etc., as to the rest, will not fit into it. If the need be, there can be a reference to the appropriate KC.

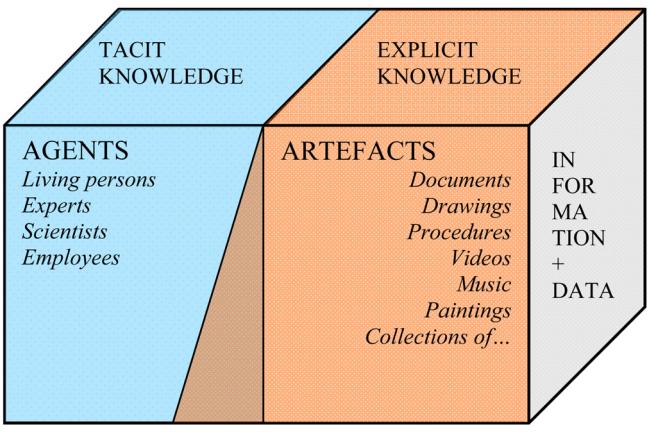

Fig. 4. Knowledge container

If a map is a KM, it should also have the following features:

1. Problem Solution

The knowledge is closely connected with a problem solution. There are many definitions of knowledge. We may say that the root of knowledge is information, which is able to solve the problem successfully. It may be shared and used for solving similar problems. This connection is strongly expressed in H a v l í č e k (2006), wherein it is stated that *"without a problem there is no knowledge"*. In a similar way we can add that without a problem there is no need for a KM.

Knowledge may be stored in KC for a long time. It even does not necessarily have to be used before a problem arises and an appropriate knowledge claim is formulated or evaluated. Information, as the basis of knowledge, may be interpreted by graphical means.

2. Dynamics

This is connected with the outline of the problem solution. The dynamics of a text may be expressed by a story. The KM transforms the story into the graphical form.

The static description of a painting is not a KM. If it is possible to tell a story connected with the painting and this story contains knowledge than the story can be taken down by a KM.

3. Knowledge Claim Reflection

The KM is created as a reaction to a concrete evaluated knowledge claim. The knowledge claim is connected with a need to solve a concrete problem and with an existing knowledge gap of the user (D ö m e o v á , 2007). The KM stands between the knowledge claim on the demand side of the KLC, and as a source of knowledge in KC on the supply side of the KLC.

4. Feedback

The effectiveness and efficiency of KM is proved by the feedback. It is necessary to prove if the user obtained and understood the knowledge, i.e. if his/her knowledge claim has been satisfied. The most important demonstration of the feedback is real activity (i.e. his/her involvement in the key processes of the organization) of the user. The experimental feedback may be used as a test, a trainer, a simulator, etc., and it is even preferred in many cases.

CONCLUSIONS

The KC contains tacit and explicit knowledge carried by living agents and non-living artifacts. KC also contains information and knowledge. The agents function independently or in co-operation with artifacts as a source of explanations, experience (tacit knowledge), etc.

The KM is a graphical expression of an outline on how to solve a problem. The KM uses knowledge, information and data stored in the KC. The KM is created as a reaction to an evaluated knowledge claim (see Fig. 5). The knowledge claim can be both real and theoretical (supposed claim).

Within the KLC the KM represents connection between the demand and supply side (see Fig. 6).

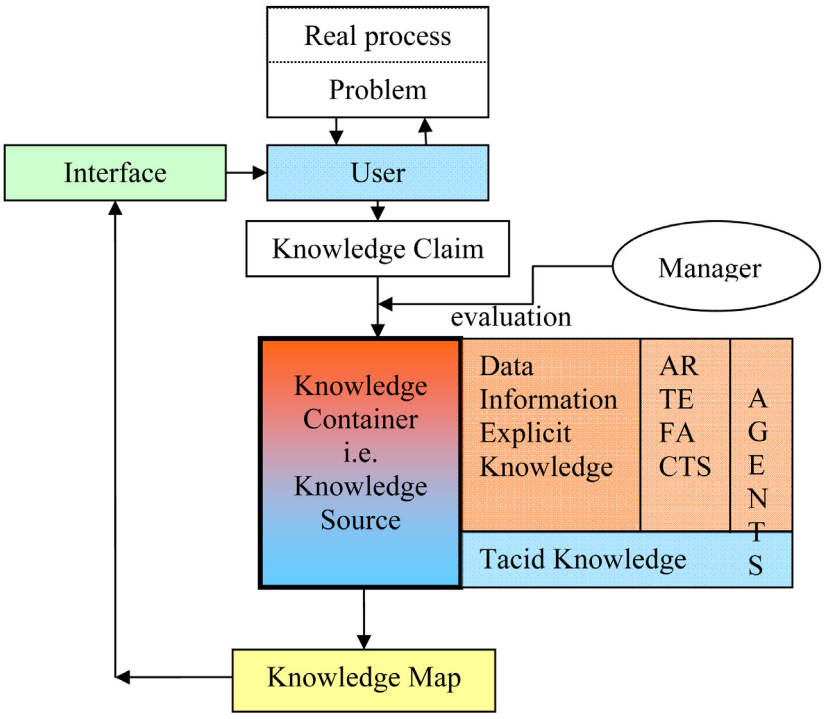

Fig. 5. Creation and Reflection of Knowledge Claim

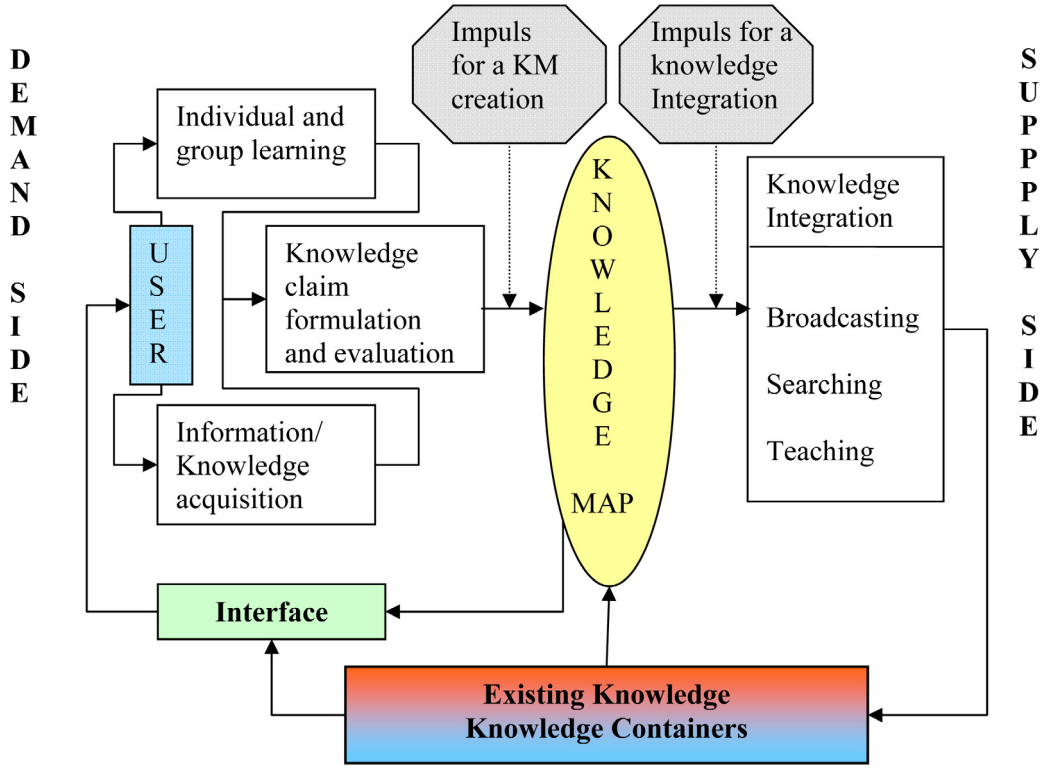

Fig. 6. Knowledge maps in KLC

The KM can reflect the dynamics of the problem solution and depict the sequence of the solution of the story containing knowledge.

The effectives and efficiency of the KM is proved by the understanding of the user, new knowledge creation in the users' head and finally in his/her real activity.

The KM can be stored in the connected KC or in an independent KC. The KM can be stored together with the description of the problem which has lead to its creation (at least with a reference to the problem).

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Role znalostních kontejnerů a znalostních map ve vytváření a sdílení znalostí.

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Cílem článku je charakterizovat znalostní kontejnery a znalostní mapy jako významné koncepční prvky životního cyklu znalosti v pojetí druhé generace znalostního managementu. Vztahy znalostních kontejnerů a znalostních map budou charakterizovány zejména z hlediska orientace na řešení problémů a nutnou dynamizaci statických struktur.

Metodika zpracování je založena na analýze vlastností a funkcí znalostních map a znalostních kontejnerů. Jejich vztah bude definován s ohledem na praktické využití při řešení problémů a na využití už existujících znalostí v organizaci.

Životní cyklus znalosti je koncepce, která integruje vznik a sdílení znalostí do lidských sociálních systémů. Má nabídkovou a poptávkovou stranu. Většina praktiků se dosud zaměřovala na jeho nabídkovou stranu, která obsahuje procesy nutné pro integraci znalostí v organizaci. Strana poptávková je rozhodující pro vznik znalosti u uživatele. Kvalifikovaná poptávka představuje ochotu a schopnost aktivně přijmout znalost a učit se. Vyjádřit znalostní požadavek ve formě vhodné, výstižné a dostatečně kvalifikované otázky je často velmi těžké, ale dobře zformulovaná otázka je důležitým předpokladem pro řešení problému. Formulace znalostního požadavku koresponduje s první fází rozhodování – „intelligence phase". Jedná se o nejdůležitější a nejobtížnější fázi rozhodovacího procesu, při níž je třeba formulovat problém.

Znalostní kontejnery obsahují znalosti vázané na živé a neživé nositele. Tacitní znalosti jsou zprostředkované živými osobami a jejich skupinami – *živí nositelé znalosti* (agents). Explicitní znalosti jsou uloženy v různé formě *neživých nositelů* (artefakty). Neživí nositelé mohou být dokumenty, počítačové záznamy a programy, obrázky, plány, výrobky, ale i obrazy, sochy, hudební díla na příslušných nosičích nebo v notovém záznamu, sbírky přírodnin nebo historických předmětů.

Ve znalostních kontejnerech jsou také uchovány výstupy procesů pro zpracování znalostí, které mohou být využity hlavními procesy v organizaci.

Živí nositelé znalostí mohou fungovat nejen jako zdroje znalostí, ale také v součinnosti s neživými nositeli. Důležitá je jejich úloha např. při vysvětlování technických detailů, použitých postupů práce a zkušeností. Tato úloha je de facto zprostředkovat a interpretovat uložené explicitní znalosti a informace.

Pro zprostředkování znalostí uložených ve znalostních kontejnerech se hodí *znalostní mapy*, které v sobě zahrnují znalosti a informace z neživých i živých nositelů.

Znalostní mapa je sjednocení nosiče, topologie a textu. Nosič je část dvojrozměrného nebo trojrozměrného prostoru. Nosič může být formalizovaný pomocí systému souřadnic nebo jinými prostředky. Topologie znalostní mapy je představována různými geometrickými útvary, obrázky nebo ikonami (šipky, spojovací čáry rovné a lomené, nepravidelné útvary). Topologie znalostní mapy je formalizovaná, pokud sestává z prvků teorie grafů.

Znalostní mapa není popisem znalostního kontejneru, ale představuje návod k použití znalostního kontejneru k řešení konkrétního problému. Znalostní mapa většinou neobsahuje doménové znalosti. V případě potřeby těchto znalostí obsahuje znalostní mapa odkaz na příslušný znalostní kontejner.

Abychom mohli tvrdit, že předkládaná mapa obsahuje znalosti a zároveň je součástí životního cyklu znalosti, měla by splňovat následující požadavky:

1. Spojení s řešením problému

Znalost je pevně vázaná na řešení problému. Existuje mnoho definic znalosti, ale obecně je možno tvrdit, že základem znalosti je informace, která úspěšně řeší problém, je možno ji sdílet a použít pro řešení podobných problémů. Znalosti mohou být uloženy ve znalostních kontejnerech po dlouhá léta a nejsou využity, dokud se nevyskytne problém a příslušný znalostní požadavek. Informace, která je základem znalosti, je v případě znalostní mapy interpretována grafickými prostředky.

2. Zachycení dynamiky

Tento požadavek souvisí s postupem řešení problému. V textu může být dynamika zachycena příběhem. Znalostní mapa tento příběh transformuje do grafické podoby s použitím relativně malého množství textu. Statický popis obrazu není znalostní mapa. V případě, že můžeme podle obrazu vyprávět příběh a tento příběh obsahuje znalost, je možné tento příběh zachytit znalostní mapou.

3. Reflexe znalostního požadavku

Znalostní mapa vzniká jako reakce na konkrétní znalostní požadavek. Znalostní požadavek souvisí jednak s potřebou řešit určitý problém a jednak se zjištěním nedostatku znalostí. Znalostní mapa tedy stojí mezi znalostním požadavkem na straně poptávky a zdroji znalostí ve znalostních kontejnerech na straně nabídky.

4. Zpětná vazba

Vhodnost a účinnost znalostních map se ověřuje zpětnou vazbou. Je třeba ověřit, zda uživatel znalost přijal a pochopil a jeho znalostní požadavek byl tudíž uspokojen. Zpětná vazba se zejména projevuje v činnosti uživatele, tj. v jeho působení v reálných procesech organizace. Je možno použít i experimentální zpětné vazby, např. pilotní kurzy, trenažéry, testy.

znalostní management; životní cyklus znalosti; poptávková a nabídková strana; znalostní kontejner; znalostní mapa

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