KNOWLEDGE IN ACTION TOWARDS BETTER KNOWLEDGE MANAGEMENT IN ORGANIZATIONS

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Abstract
This article presents a practical perspective on the knowledge management in organizations considering the knowledge engineering process as the producer of knowledge assets that makes a better business process. Knowledge in action is based on the new thinking that recognizes knowledge an important factor of production in a competitive intelligent business environment. The importance of knowledge in diverse industry settings should reinforce knowledge management decisions to unlock knowledge that changes the way how business processes interact with customers or clients, provide unique value in their business space, and transform their operations and workforces. The main contribution is the use of model-based approach to create a conceptual common set of knowledge management activities. It proposes to create packages of current practices and elaborates use case diagrams for an introductory analysis model description of interactions. Graphical notation is recognized very useful in clarifying major tacit aspects of knowledge, in a way enabling and stimulating communications with different stakeholders.
Keywords: knowledge engineering, knowledge management, knowledge systems, knowledge representation, conceptual modeling, UML

1. INTRODUCTION

Knowledge management (KM) is a field emerged in business administration. It takes knowledge as a central element for organizational decision-making and attempts to realize a system with the goal to bring value to the business process. KM is considered that carries the seeds of many bordering disciplines, such as human resource management, knowledge engineering, information technology, or organizational consultancy (Preece et.al., 2001). Under umbrella of knowledge management there are various consolidated knowledge technologies, such as data mining, ontology engineering, semantic web or knowledge graphs, as well as technologies for intelligent digital collaborative work that range from email to desktop sharing systems and video conferencing.

KM domain intersects, complements and specializes areas of knowledge-based engineering (KBE) and knowledge engineering (La Rocca, 2012). The development and deployment process of a KBE software system demonstrates this. Usually the deployment of a KBE system is part of a larger and heterogeneous engineering design framework, where it is integrated with other tools by means of a workflow management system (Verhagen et al., 2012).

The intelligent use of these technologies provides efficient software tools and applied techniques. The core features of many knowledge technologies include functionalities relevant to knowledge and its management. Here are realized common capabilities to identify valuable knowledge in an organization, to capture and formalize knowledge for more sharable and efficient reuse, to represent and store knowledge to improve access, maintenance and transfer and to embed knowledge in knowledge systems to provide benefit.

It is important to relate the central concepts in knowledge management to features and tools of knowledge engineering methodologies and to manage with consistency their evolution and association. This article identifies and describes the main activities that make knowledge management a facilitator and stimulator for knowledge processes in business organizations. It uses Unified Modelling Language (UML) standard notation to graphically represents models of interactions (UML, 2021). Knowledge engineering process places strong emphasis on the conceptual modelling of knowledge-intensive activities. Graphical notation is recognized very useful in clarifying major tacit aspects of knowledge, in a way enabling and stimulating communications with different stakeholders including managers, knowledge providers, end users, customers, who often do not have

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a background in formal languages of information technology and knowledge representation (Dobrica, 2018, Zgodavova et al., 2020).

This article brings into attention the general goal of the knowledge management on supporting all the initiatives that can enable a more efficient and effective use of the knowledge assets as resources in the organization. Knowledge in action is driven by the domain of knowledge engineering that is the producer of conceptual knowledge models to be used by various applications building knowledge-based technologies.

2. BACKGROUND

2.1. Knowledge

In the area of knowledge management, it has been pointed out many times that a large part of knowledge is not explicit, but tacit (Schreiber et al., 2010) (Babar et al., 2009). Knowledge is often not explicitly describable by the people who possess it, nor is it easy to explain and to formalize in physical or digital publications. Often, it is a background capability, partly unconscious and stemming from experience, that is used in problem-solving tasks including engineering design or software architecture. Tacit knowledge, such as skills or crafts is personal, private and often hard to communicate and difficult to formalize using formal languages. Explicit knowledge is written in formal, systematic languages and is communicated much easier.

A deeply perspective about tacit and explicit knowledge is introduced in the book "The Knowledge-Creating Company" by Nonaka and Takeuchi, (1995) where a entire theory about knowledge and its creation is built (Nonaka and Takeuchi, 1995). Four modes of knowledge production are identified namely: socialization, externalization, combination and internalization. Socialization produces tacit knowledge from tacit knowledge. Externalization produces explicit knowledge by using tacit knowledge of knowledge-intensive practices and formulating them in explicit formal procedures. Combination produces explicit knowledge by creating new knowledge through the integration of different pieces of explicit knowledge. Internalization produces tacit knowledge from explicit knowledge in a form of a human behavior able to carry out a periodic task successfully without thinking about it. The rationale is that performing a task frequently leads to an internal personal state where tacit knowledge can be automatically activated.

A spiral model that includes a continuous ordered sequence of all four types of knowledge production is associated to organizational knowledge creation needs. The aim of knowledge management is to properly facilitate and stimulate these knowledge production processes, so that an upward, dynamic spiral of knowledge emerges.

Explicit knowledge representation in computing systems has faced many challenges during the recent 20 years (Pascal, 2021). The long term goal of building knowledge bases together with all the necessary methodologies required to create, maintain, and use in software systems is discussed from different perspectives in the literature. One perspective is related to provision of understandable knowledge, ontology engineering and formal languages with logic based semantics that accepts reasoning over the meaning of knowledge. Another perspective that has been viewed recently is to provide added value to knowledge integration and management by applying Semantic Web technologies. From this perspective, the aim is to establish efficient methods and tools for knowledge sharing, discovery, integration, and reuse. The third perspective is the one that investigates the applications of the standardized semantic web knowledge and the key concepts including ontologies, linked data and knowledge graphs (Noy et al., 2019) .

The web is appreciated as a realization of explicit knowledge to be shared and reused. The semantic web field has strong relations to knowledge representation and reasoning as a sub-discipline of artificial intelligence, as knowledge graph and ontology representation languages can be understood and are closely related to knowledge representation languages, with description logic acting in the main role, as the foundation for the Web Ontology Language OWL.

The Web development changes the traditional ways of perception of data, information and knowledge (Gutierrez and Sequeda, 2021). Knowledge at large scale is possible due to advances in hardware and new systems that make it possible to generate, store, process, manage, and analyze data in a Big Data context.

Better description logic profiles for knowledge representation and software systems that implement reasoning algorithms have influenced the evolution in this domain. In the Big Data context with powerful hardware available statistical techniques advances knowledge systems that deduces knowledge from asserted knowledge. The connection between data and knowledge is build on the achievements of knowledge engineering, description logic and graph data models.

2.2. Knowledge engineering

For many years it has been discussed about converting tacit into explicit knowledge. The importance of tacit knowledge is nowadays widely acknowledged in knowledge engineering and management. In such a view, knowledge engineering methodologies are useful in two of the explicit knowledge production processes, namely externalization and combination (Jałowieckia, Kłusekb and Skarkaa, 2017) (Schreiber, 2010).

Under perspective of a model-based engineering approach this can be conceptually defined by an interface concept that is frequently used in software systems architecture development (Dobrica and Ovaska, 2009) (Dobrica and Niemela, 2008). A communication interface having a knowledge acquisition operation can be used to model the knowledge externalization process. The concrete realization of the interface operation is the knowledge capture that is described in many studies as the bottleneck to implement knowledge systems (Kendal and Creen, 2007) (Quintana-Amate et al., 2015). The behavior of this operation is realized based on various proposed solutions for each business domain.

Fruitful results of projects from various research initiatives looking for solutions to the bottleneck problem, made it possible a fast and intensive evolution and development of the knowledge acquisition topic. Most of the achievements have been recognized belonging to mature fields of knowledge engineering (Schreiber et al., 2010), ontology engineering (Calero et al,, 2010), semantic web (Pascal, 2021) or knowledge graphs (Noy et al., 2019).

Knowledge graphs are considered critical to many enterprises today because they provide the structured data and knowledge that drive many products and make them more intelligent.

The area of interest is the development of knowledge systems that help business organizations to increase the efficiency of their work. Knowledge management department in an organization is the main driver of decisions regarding the development of knowledge-based engineering software systems. Knowledge capture, knowledge representation, knowledge retrieval, as well as knowledge coding and inference are considered critical and many times bottlenecks of the development phase towards the realization of an efficient knowledge system. The field of knowledge engineering on the acquisition and codification of relevant knowledge have to be considered in the development of knowledge-based support systems. The use of knowledge engineering approaches and methodologies supports mostly knowledge acquisition activity which represents an essential step toward the development of any knowledge system.

3. PROPOSED APPROACH

The context of using knowledge in the organization business process and its management is presented in Figure 1. The approach is based on CommonKADS methodology (Schreiber et al., 2010) and the assumption that knowledge should be the main enabler to successfully carry out the business processes within the organization. The main purpose of structuring business processes is to create and deliver value for several categories of recipients (i.e. users, customers, clients) of its products or services. The main process that has activities to define a knowledge-management strategy needs to have an outside-in direction. This direction flows from the recepients in a realistic and measurable feedback form. A knowledge management strategy process has to be initiated by considering the value-creation goals of the organization, and how this value is delivered by the main organization's business processes. Knowledge assets are those parts of knowledge that represent the main source for organization business processes to deliver value. In this defined context the knowledge management strategy output is to identify the most useful actions for increasing the knowledge capacity underlying the structured business processes.

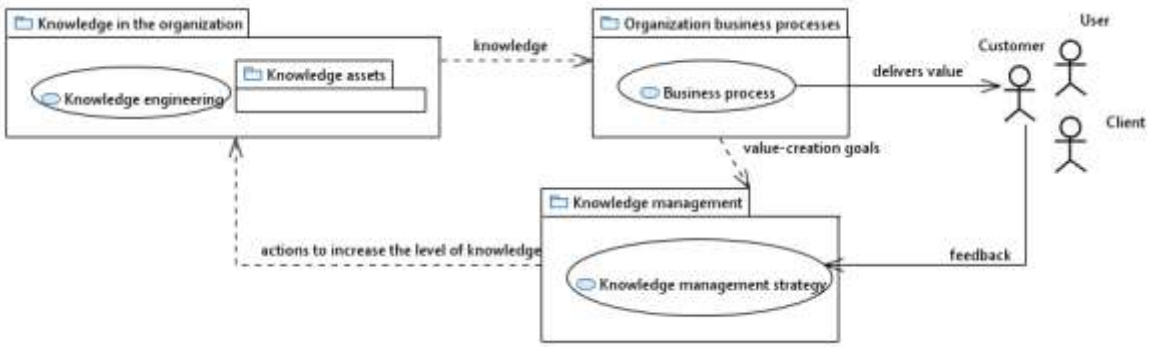

Figure 1. A general view of knowledge in an organization.

Knowledge engineering is the main process able to contribute with adapted and new knowledge assets for this general purpose of the management strategy. There is a wide range of managerial actions that can improve and control the flow and level of knowledge. Among these can be mention those that aim to create multifunctional or cross-disciplinary teams to build a richer knowledge base for innovative service or product design. Literature provides examples of actions (Schreiber et al., 2010) that include the following:

- Concentrate knowledge within special expertise centers to achieve a sufficient critical mass. This action is mostly applied in emerging advanced technology areas.
- Distribute knowledge by reallocating knowledge providers from headquarters to local offices by means of decision support systems. This action can be considered in banking or insurance companies, to better and more quickly serve the local customer with banking and financial services.
- Transfer knowledge to target groups by taking the advantages of the new opportunities for attractive sharing and reusing of knowledge on the Internet. This action can be considered by research organizations to rethink and redesign their knowledge gathering.
- Install knowledge repositories in a form of distributed or federated databases of projects carried out and lessons learned. Internationally operating enterprises may consider this action to strengthen worldwide services management consulting.
- Facilitate the aggregation of new knowledge systems in the forms of knowledge graphs to organize repositories that enhance knowledge sharing and reusable from various and multiple libraries. This action brings benefits and increases the speed of innovative service engineering, thus reducing time to market.
- Create new knowledge feedback loops from customers on a regular periodic basis is an action that brings benefits when used to redesign certain services or products. Automotive companies have considered this action and benefits of good results.
- Create new customer services based on network-oriented virtual organizations with a better capability to speed up the flow of knowledge. The benefit is a better competitive position in a deregulating market.

The experiences of organizations regarding knowledge-based thinking include many lessons-learned that should be taken into considerations. There is always a challenge for a knowledge manager to deal with the fact that knowledge is an organizational asset and, at the same time, mostly resides in individual people. Therefore management actions should not have a mechanistic nature, but they have to be people-oriented. Also a management strategy have to be focused on the nature of knowledge as a potential source for action to support main as well as secondary business processes. In this way the knowledge can be used in a specific organizational context to realize its value.

The current world tendency of the information technologies capabilities is to overload its users with a high volume of data and information. Knowledge management strategy has to act against this tendency by considering actions that are supplemented with target or a purpose oriented sharing of experience and

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expertise. A bottom-up orientation approach is recognized for gaining success based on practice by creating and sustaining knowledge pull derived from ongoing business projects needs.

A special view, linked to the fact that knowledge is an entity connected to other entities in a large scale knowledge graphs, has to be considered for limitations that could occur in knowledge transfer between intensive-knowledge projects. Traditional approaches that consider knowledge as an attribute of competent people have to be wisely converted into knowledge-based intelligent agents with guaranteed and validated competency.

More than a knowledge transfer seen as a communication from a producer to a consumer is the idea of knowledge sharing. Knowledge management facilitates knowledge sharing by people and increases their connectivity. Many knowledge managers have to think projects in terms of co-production of knowledge and to stress the importance of multifunctional and multidisciplinary teamwork in knowledge-intensive organizations. Monolithic or distributed in a network of different companies at different locations have a main business purpose to achieve a joint goal. Knowledge engineering is the constructive and collaborative process that has the central activity the modelling of knowledge to be used in this knowledge exchange mechanism. The knowledge sharing includes not only communication, but also recreation on a common understanding foundation.

Knowledge management is tightly connected to knowledge engineering process by using the results produced in this process. Thus knowledge-management actions have to be applied decisions about development projects that create knowledge assets, including knowledge models. Knowledge assets are resources for the knowledge management activities. This perspective on knowledge as a resource includes the availability aspect of a resource. This means that knowledge has to be available at right time, at right place, in the right shape and with the needed quality and against the lowest possible cost.

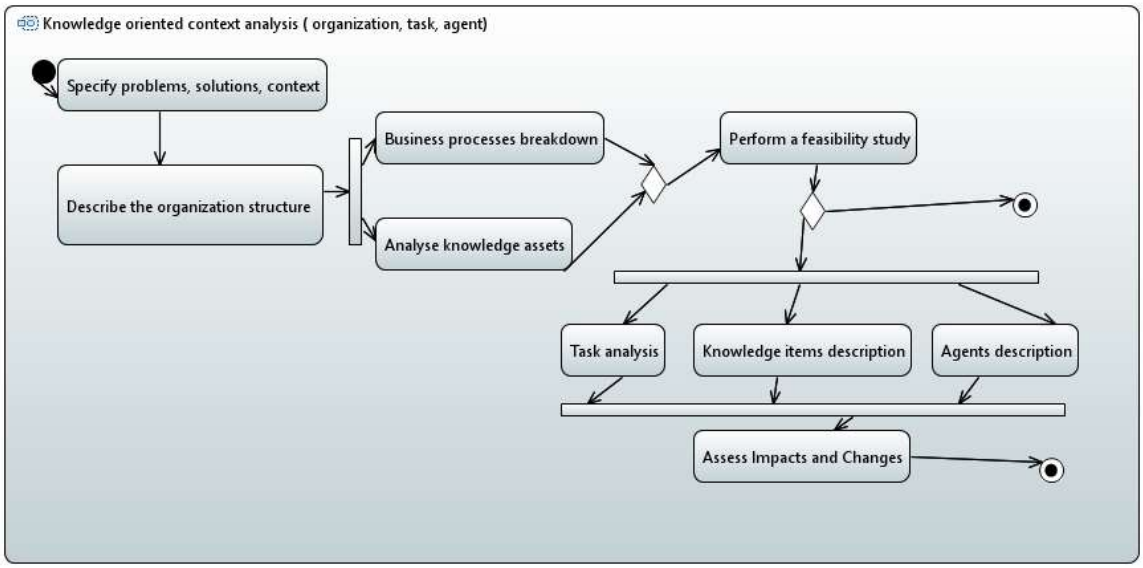

Figure 2. Actions in a knowledge-oriented context analysis.

Knowledge as a resource for a management activity has many and various properties and has to be managed differently from other physical resources. Knowledge management initiates and executes actions that operate on the knowledge resources, consisting of knowledge assets. The monitoring active process of these resources send action messages to the knowledge engineering and receives results in the form of reports and observations about the realization of the required actions.

CommonKADS methodology takes into considerations knowledge management and proposes three different types of activities: conceptualize, reflect, and act. These are related to the model sets on the context level, organization and agent. For example a knowledge management action may require the building of a knowledge system that increases the quality of knowledge in the organization and the availability in terms of time and place. Also other changes might be considered and these addresses the context of the knowledge system

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(Figure 2). The organization model might be used to show the resulting change in people and structure or the agent model that may include a new agents. Both the organization model and task model reflect changes in the business process and the resolved knowledge bottlenecks. A new fine grained knowledge specification might be considered in some cases when knowledge changes its form, from tacit to explicit, based on model knowledge creation cycle (Nonaka and Takeuchi, 1995).

Knowledge management and knowledge engineering are attached to an organizational business process, but with a different scope. Knowledge engineering main purpose is to provide explicit knowledge representation when knowledge systems are built based on a knowledge manager decision. A knowledge system becomes the tool that can be used to solve a knowledge resource problem detected, analyzed, and prioritized by knowledge management. Figure 3 presents various process roles that might be considered. CommonKADS discussed about a clear distinction between knowledge manager, project manager, knowledge engineer, knowledge provider, knowledge user and knowledge system developer.

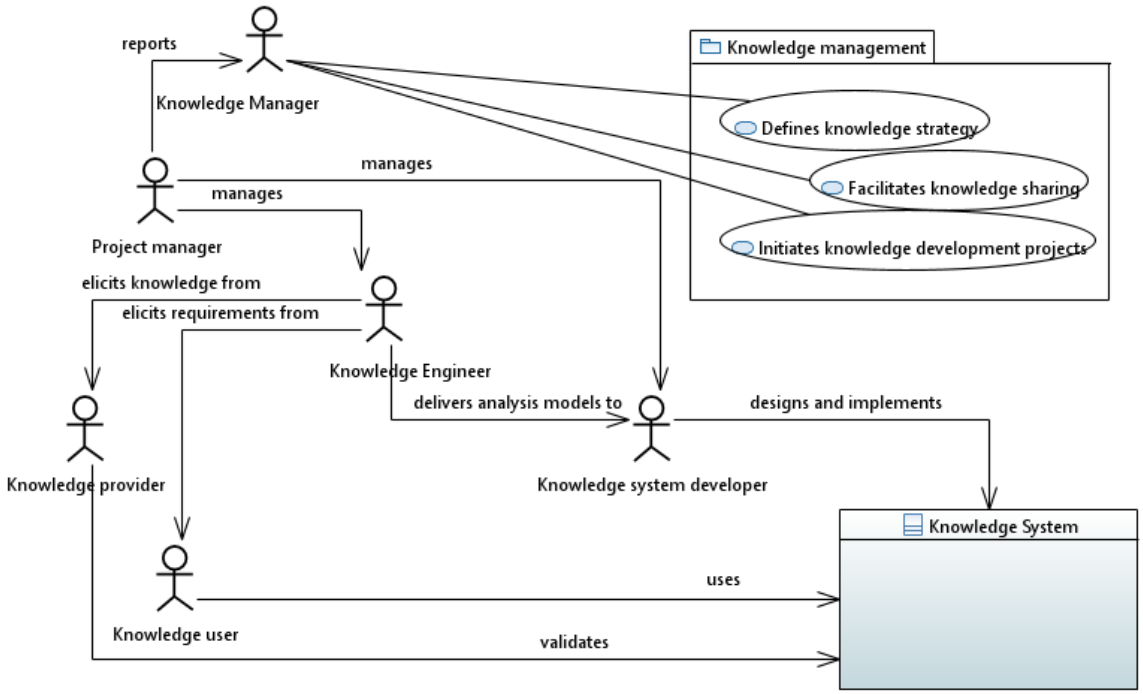

Figure 3. Interaction and relations between various process roles.

Conform to CommonKADS the main link between knowledge management and knowledge engineering is found at the knowledge object level. For the management level the focus is the managing knowledge, which is not the same as managing project for knowledge-system development. The main model for the management-level activities in knowledge management is the cycle depicted in Figure 4. The three main activities in this cycle are conceptualize, reflect and act.

The main goals of the conceptualize activity are to get a view on the knowledge in the organization and its strong and weak points. It involves the knowledge assets conceptualization and analysis and inspection of properties with the goal of knowledge bottlenecks discovery. A specific management perspective is on finding a proper scope looking for knowledge bottlenecks, new business opportunities, and human resource problems and choosing a proper level of detail for analyzing the knowledge. Knowledge visibility and its importance are also included in the conceptualization. Reflect is a management activity that is considered not being in the domain of knowledge engineering because the aim is to identify improvements and create and decide about improvement plans. Acting means initiating the realization of the improvement plans and monitoring their progress. Here knowledge management is similar to many other management concerns in an organization.

Among these it provides knowledge-oriented organization analysis. Models of tasks and agents are inputs for clarifying knowledge bottlenecks in specific areas. They are relevant to business process redesign and

improvement in domains where knowledge work is involved. Also they are drivers to a better integration of information technology into the organization.

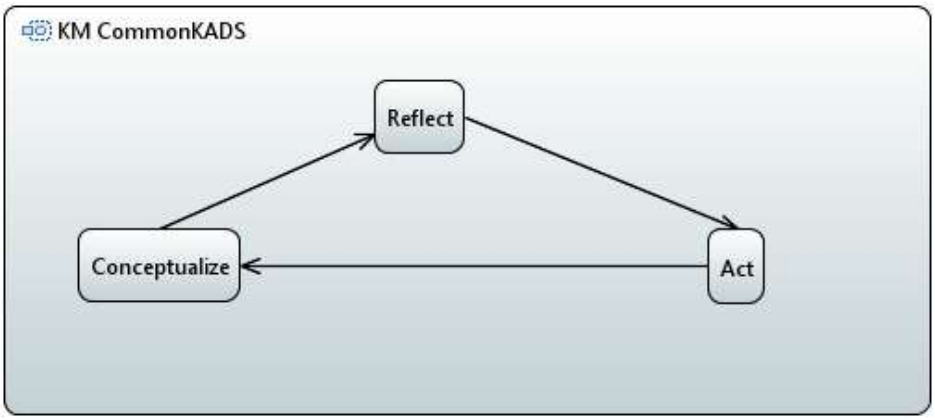

Figure 4. Knowledge management activities cycle.

Knowledge engineering places strong emphasis on the conceptual modelling of knowledge-intensive activities. Graphical notation is recognized very useful in clarifying major tacit aspects of knowledge, in a way enabling and stimulating communications with a variety of stakeholders (managers, specialists, end users, customers) who often do not have a background in formal languages of information technology and knowledge representation.

4. CASE STUDIES TO CONSIDER IN COMMON KNOWLEDGE MANAGEMENT ACTIVITIES

Knowledge management can be structured into a common package of activitities called current practices (see Figure 5). Among these common practices are considered to be included the following: the availability of discussion forums, document management systems, capability management systems, lessons-learned knowledge base systems, standard operating procedures, corporate technical operations knowledge and service to locate historical/current corporate knowledge on a specific topic. Discussion forums are provided as the means to ensure that the organization effectively supports existing (or desired) communities of practice. Document management systems include numerous features that are defined by the need of organizations to ensure that competency criteria are defined in a structured form based on the selection of the right tool. Capability management systems are build from an organization need to define a meta-knowledge that serves as knowledge containers to capture important and critical employees' capabilities to be considered when employees' curriculum vitae database is populated.

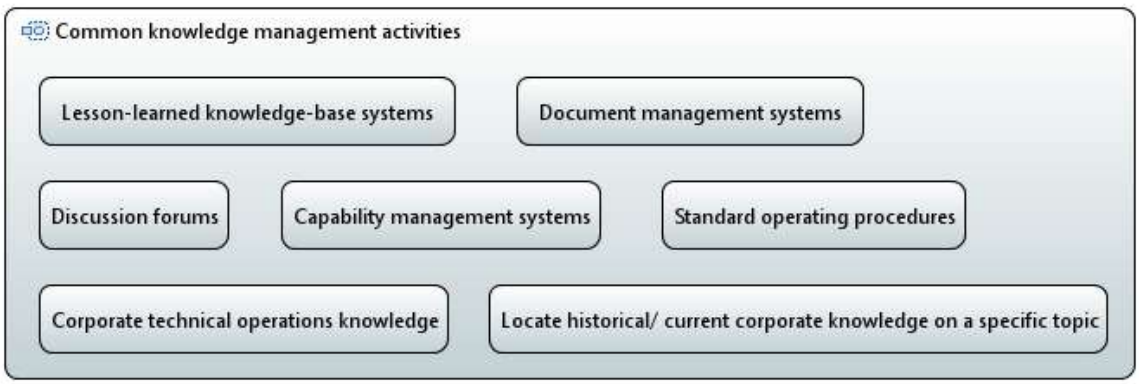

Figure 5. Common knowledge management support systems.

Lessons-learned knowledge base systems for larger organizations can be structured in several parts. An approach could consider an one-to-one mapping to the organization structure.

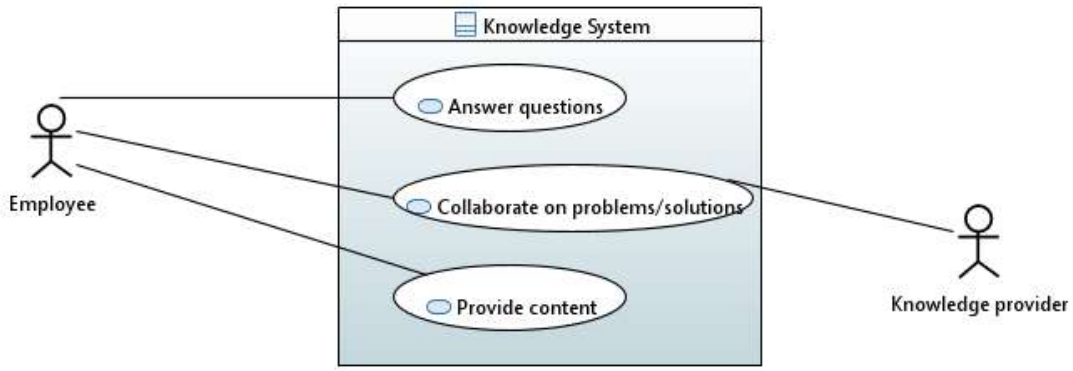

Figure 6. Use case diagram includes employee knowledge needs use cases.

The needs of organizations to address employees knowledge is the main source of requirements for knowledge-based support systems. These systems can be built to provide access to the key knowledge providers in the organization to answer their questions, collaborate on relevant problems/issues, and/or provide actual and the most current domain content (Figure 6). Knowledge engineering provide techniques to capture knowledge that resides in the minds of experts (tacit knowledge). In addition standard operating procedures, guidelines or templates need to be captured to address each employee knowledge needs with the purpose of sharing and reusing such knowledge into the organization (Figure 7).

Corporate technical operations knowledge support requirements of employees to inquire about technical solutions that are relevant and related to hardware and/or software platforms being provided to be used in the business process by the organization. It's important to mention here a support to provide solutions about known errors, software patches, issue resolutions, and other specific and updated information concerning the hardware and software configurations that are considered to be used in the organization.

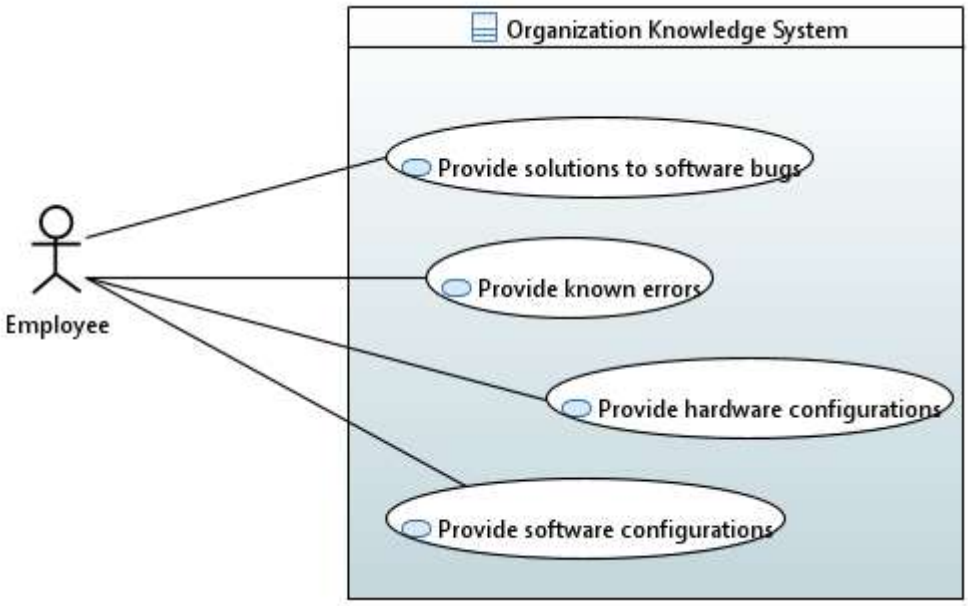

Figure 7. The use case diagram presents use cases to provide knowledge for technical support activities.

Knowledge management can support business organization to bring new product innovations to the marketplace. In this area usually occurs a typical situation with duplication of effort due to not having the prepared employees trained to perform the research to bring a product innovation to market successfully and

in a timely manner. By locating in real-time the current and/or historical organization knowledge on a specific topic makes it possible to avoid reinventing successfully practices.

5. CONCLUSIONS

Knowledge in action is based on the new thinking that recognizes knowledge an important factor of production in a competitive business environment. It proposes that knowledge should be an individual entity, a resource to be used to produce more knowledge. The inference of knowledge from asserted knowledge is a determinant solution that drives innovation in many business domains and makes them more intelligent.

Various systems build on the achievements of knowledge engineering, description logic and graph data model advances new achievements in sharing and reusing knowledge. Within an organization providing a shared knowledge to allow communication services it is recommended to use similar vocabulary and to reuse definitions and descriptions that others create. Also a compact formal representation that developers can use to infer new knowledge and build up the knowledge is a benefit to be consider.

In the context of the increased interest in the semantic web field technologies this article joins to the currrent trend regarding domain consolidation through getting value by connecting various conceptual models. It considers that the power of the semantic web technologies can be used in knowledge systems development based on the need to keep a consistent association between knowledge management in business organizations and knowledge engineering process.

The importance of knowledge in diverse industry settings should reinforce the idea that it should be fundamental to understand and explore its engineering methodologies and technologies. New opportunities exist today for knowledge management in organizations. Intelligent organizations must realize that the future is a promise of the new systems that unlock knowledge that changes the way how they interact with customers, provide unique value in their space, and transform their operations and workforces.

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