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Knowledge Goals as an Essential Component of Knowledge Management

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Knowledge Goals as an Essential Component of Knowledge Management*

Abstract: Knowledge goals are one of the fundamental elements of knowledge management. They should be derived from corporate goals and define objectives for knowledge management in a company. Without the creation, use and verification of these goals, effective knowledge management is unthinkable. However, this is usually not well supported by information technology. Holistic systems which can assist all processes in managing knowledge goals are virtually non-existent. In our project, we develop such a holistic approach termed Knowledge Valuation Management (KVM) system. In this paper, we present some key components of the system together with some examples.

Key Words: strategic knowledge planning, design science, knowledge management system

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1 Introduction

Knowledge can be identified as one of the fundamental elements of business success in many branches of industry (Conner and Prahalad, 1996). For the effective use of the resource knowledge in a company and particularly in knowledge-intensive firms, it should be an element of strategic planning. Consequently, it is important to capture, measure and valuate knowledge to give the corporate knowledge management a strategic direction. It is fair to state that these issues have not yet been satisfactorily solved, yet.

The strategic management approach “knowledge-based view” underlines the meaningfulness of the resource knowledge in companies. In this approach, knowledge can be understood as the element for combining and applying tangible resources. It can be embedded and carried through the organizations culture, routines, policies, systems, documents and individual employees (Grant 1996), (Spender 1996). Al-Laham (2004), refering to different empirical studies (e.g., (Henderson and Cockburn, 1994; McEvily and Chakravarthy, 2002)), presents one way in which these connections can be explained. He distinguishes a direct association between the knowledge base of a company and the company’s business success and an indirect association through the choice of a knowledge strategy.

Information technology plays an important role in these complex activities. A large number of tools can be found for the operative aspect of handling the resource knowledge, e.g. Livelink ECM™ [1]. Information systems for the strategic part of knowledge management are seldom available and mostly just for information presentation without any kind of integration into an existing corporate IT-system landscape (Bornemann and Alwert, 2007). Existing tools for corporate strategic planning[2] are incapable of planning the ill-structured resource knowledge. A possible solution is demonstrated by our Knowledge Valuation Management (KVM) system. The system supports the process of strategic knowledge planning by providing a basis for the valuation of knowledge. The aim is to verify the attainment of knowledge goals. With the help of this system the knowledge planning process, which has at best been unstructured or even non-existent up to now, gets a tool for the continuous verification of the achievement of knowledge goals in order to better handle knowledge as a valuable resource.

The scientific methodology of this paper is based on the construction-oriented approach of design science (Hevner, March, Park and Ram, 2004), which is dominant in German-speaking information systems (IS) research (Lange, 2006). Design science in IS aims toward the creation and evaluation of innovative artifacts, such as information systems, conceptual frameworks and process models. Based on a requirements analysis that also evaluated existing architectures and approaches, we present a framework and IS architecture for knowledge valuation and strategic knowledge planning. The prototype will be implemented in company system landscapes with the support of our business partners in this research and the results will be evaluated empirically and used to improve the framework and methods.

The next section briefly reviews related work and defines our understanding of knowledge valuation. Then, our IS architecture for strategic knowledge planning is outlined. We finish with some conclusions and indications of future work.

[1] http://www.opentext.com/

[2] See, for instance, www.corporate-planning.com.

2 Related Work

The real challenge of the "Knowledge Age" is the effective handling of the resource knowledge within the management cycle. This cycle can be described through planning, realization and control. Planning reflects the strategic aspect, the actual realization is the operative component and control represents the verification of both. Strategic knowledge planning forms the basis for all further knowledge-related activities. It allows us to set and verify the attainment of knowledge goals and gives advice for handling the identified results. The output of this process is a strategic plan, setting a framework and milestones for the operational part of the knowledge management cycle.

The discussion of the value of the resource knowledge fills an endless list of publications (e.g. (Sveiby, 1997; Ford and Staples, 2006; Green, 2006; Tobin, 1969)). However, each of these publications takes a different perspective on how knowledge can be measured and valuated. The main conclusion is that "knowledge is valuable" in different ways. Therefore, knowledge valuation methods can be divided into different categories. Some approaches give a monetary value of knowledge in a company as their result. Other methods aim to support strategic management. A structured overview and comparison of existing knowledge valuation approaches can be found in (Schorcht and Nissen, 2008).

In this paper, the following definition of knowledge valuation is used: "Knowledge valuation represents the verification of the attainment of knowledge goals." According to (Probst, Raub and Romhardt, 2002) the process of knowledge valuation can be split in two steps. The first step involves the measurement of knowledge, which makes variances in the corporate knowledge base visible. The second step describes the interpretation of these variances with the help of knowledge goals. It is necessary to emphasize at this time that knowledge valuation does not refer to a monetary valuation of knowledge but rather the validation of the achievement of the knowledge goals as an important part of strategic knowledge planning.

3 Knowledge Valuation Management (KVM) System

The goal of the KVM system is to support strategic decisions regarding knowledge as a resource. The KVM architecture describes a holistic view of the process of knowledge valuation. This encompasses the capturing, measurement and valuation of knowledge as well as the presentation of the results and the integration into an existing corporate IT-system landscape. The approach divides the proposed system into three base layers and a fourth layer called the integration layer. A rational for this architecture can be found in existing knowledge valuation approaches (e.g. Scandia Navigator). More background information on the KVM architecture as well as an in-depth explanation of each function of the KVM modules can be found in Schorcht, Nissen and Petsch (2009a).

The tool is intended to support and improve the daily work of a company knowledge manager. With the help of the KVM system, the knowledge manager (1) gets an overview of the relevant knowledge in the company, (2) determines a value of this knowledge w.r.t. the defined knowledge goals and (3) gains assistance in making strategic decisions with the help of different methods of analysis (e.g. portfolio techniques).

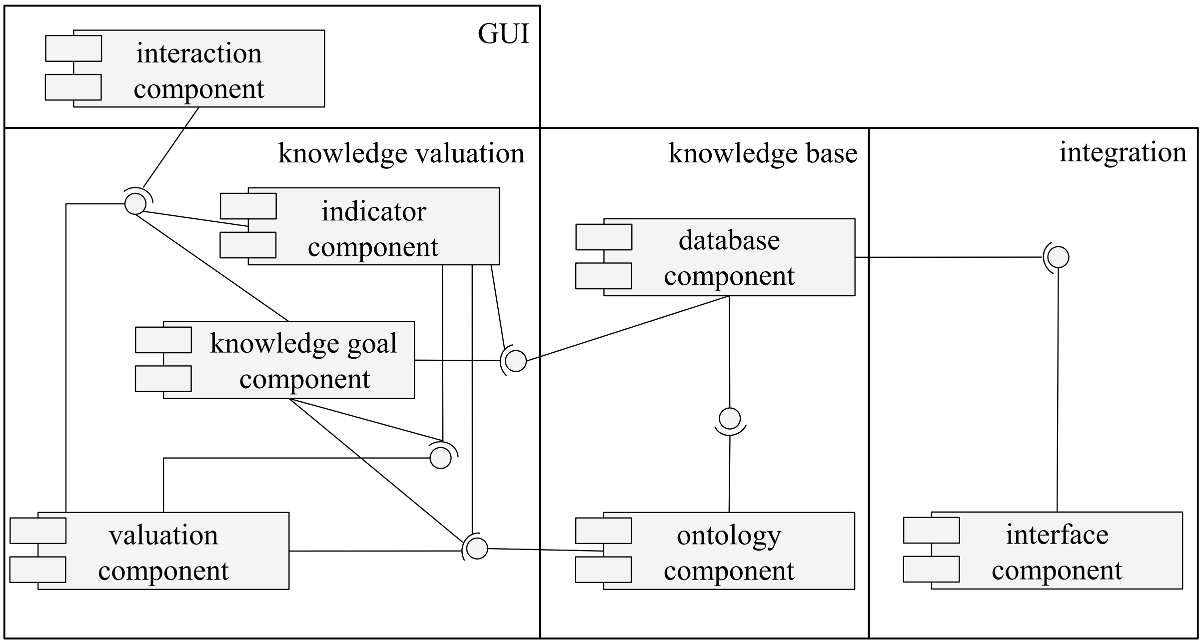

Figure 1. Main components of the KVM system

Figure 1 presents the main components of the KVM system. The components are arranged into four modules. The GUI with the interaction component represents the interface for user access to the KVM system. Several important tasks can be identified in this component. Users can create, change and delete knowledge indicators and knowledge goals. Furthermore, it is possible to build links between indicators and goals, which will be explained later in this paper. Also, methods for strategic knowledge planning, such as portfolio analysis or scenario analysis, can be executed. The knowledge valuation module integrates all functionality for handling the knowledge indicators and goals. The knowledge base module with the database component provides the actual access to the KVM database. Every request for information from the database must be carried out through this module that provides storage and other required functionality. The integration module represents the interface to the external systems. It contains methods to access all connected systems, such as project management systems, knowledge management systems or workflow management systems (more details about connected systems can be found in (Schorcht, Nissen and Petsch, 2009b)). Some components which are of particular importance for the knowledge valuation process are highlighted in more detail below.

4 Knowledge Indicator and Goal Component

Meyer (2008) describes indicators as numbers with information about a specific topic. Hence, indicators illustrate facts about an object to be measured, i.e. knowledge. Knowledge indicators are fundamental for valuation, control and management of knowledge resources. They allow to capture and measure knowledge in a company, possibly using different measurement methods (Edvinsson and Malone, 1997; Sveiby, 1997). Lehner, Amende, Haas and Wildner (2007) provide support on finding the right knowledge indicators and measurement methods with the help of empirical studies. Knowledge indicators represent the background for the analysis function of the knowledge valuation process. Because of the strategic direction of the KVM system, the indicators are not necessarily related to monetary values. KVM system elements used for the indicator component are described below.

Knowledge goals are a sub-area of corporate goals and should be incorporated into the latter (von der Oelsnitz and Hahmann, 2003). They define where knowledge within organizations should increase, solidify or be disregarded. Strategic knowledge goals give a direction for knowledge management activities (Probst, Raub and Romhardt, 2002). They serve as a basis for the measurement and interpretation of the success and failure of knowledge management activities.

For this reason it is necessary to cast knowledge goals into a form that can be handled by information systems. In the KVM system knowledge goals are modeled by the user with the help of a graphical interface, where also metadata can be entered. This can include a unique name of the knowledge goal or connections to other goals, among others.

A formal description of the knowledge goals is required for their use in the KVM system and various methods exist for supporting formalization. Most of these methods are based within the research field of requirements engineering, for example the Goal-oriented Requirement Language (GRL), the Non-Functional Requirements Framework (NFR) (Chung, 2000) and the Knowledge Acquisition in automated Specification system (KAOS) (van Lamsweerde, 2001). The easiest way to model knowledge goals is to visualize them with software tools such as MS Visio^{TM}. Another possibility is the so-called strategic linkage model (SLM). The SLM represents the collectivity of all goals with their connections and cause-and-effect relationships (Kaplan and Norton, 2004). Goal modeling methods were deeply analyzed as part of our research project, but not further detailed here. Based on this comparison, we use the strategic linkage model (SLM) in the first prototype of the KVM system. This model offers simplicity, good tool support and various possibilities for visual representation

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Symbol	Name
	Soft goal
	Hard goal
	Strategic goal
	Operative goal
→	Connection directed
+ −	Connection influence
1...5	Connection intensity

Figure 2. Modeling symbols for knowledge goals

Knowledge goals can be subdivided into different categories, such as structuring on the time horizon, measurability, functionality or action (van Lamsweerde, 2001). The KVM system uses two distinctive features (time horizon and measurability). Measurability is represented using the goal types "soft goal" and "hard goal". Soft goals are only measurable with the help of indirect indicators or other knowledge goals in the system. Examples for this kind of goal are "increased knowledge transparency" and "knowledge-oriented corporate culture”. On the other hand, hard goals can be directly represented by indicators. The second distinctive feature is the time horizon. Knowledge goals can be described by their time range. For example, Probst et al.differentiate between normative, strategic and operative knowledge goals (Probst, Raub and Romhardt, 2002). Within the scope of the KVM system, we use strategic and operative goals to support knowledge planning. Because of the long time horizon, normative knowledge goals describing a company’s overall knowledge vision are not considered.

There are three modeling elements for representing knowledge goal connections. First, a directed graph shows the relationship between two goals. The direction of the graph gives an indication of the dependence of goals. The influence and intensity of the connection are described in detail in the graph. With the help of plus and minus symbols, the positive or negative influence of goals can be demonstrated. A scale between one and five represents the strength of the connection. For example, a sub-goal with the symbol plus and the number four has a strong positive influence on the overall goal. The attainment of a sub-goal implies progress toward the attainment of the overall goal. On the other hand, a negative influence between two overall goals is possible. For example, the attainment of the goal “increase knowledge transparency” precludes the attainment of the goal “reduce uncoordinated knowledge distribution”.

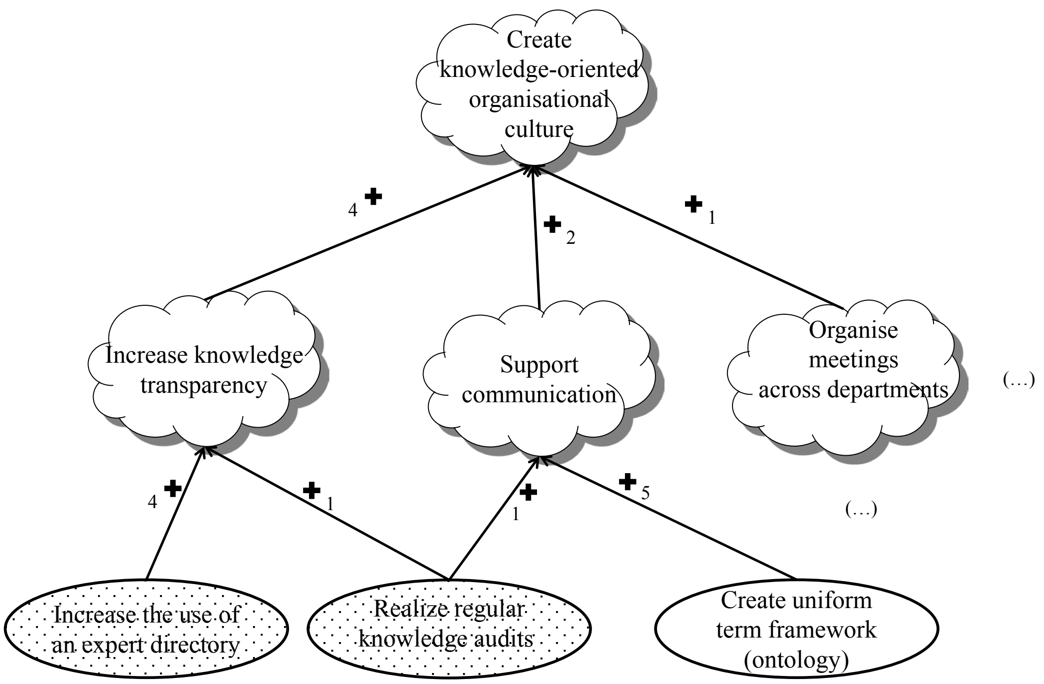

Figure 3. Knowledge goal modeling

An example for the use of modeling elements is shown in figure 2. There, only a part of one possible knowledge goal hierarchy is shown. The overall goal “create knowledge-oriented organizational culture” describes a strategic soft goal. The attainment of this goal can only be measured through indirect indicators as well as with the help of sub-goals. Also, the sub-goal “increase knowledge transparency” has a positive influence on the main goal. Better knowledge transparency in an organization can bring about an improved knowledge-oriented organizational culture. The next section demonstrates the use of knowledge goals and knowledge indicators in the valuation process.

5 Valuation Component

The main function of the valuation component is to compare the captured knowledge (represented through knowledge indicator values) and predefined knowledge goals. The result can be described as the attainability of knowledge goals. Every knowledge goal is assigned a set value. For example, if the chief knowledge officer (CKO) wants to know the level of achievement of the knowledge goal "increase knowledge transparency", he or she initiates a request through the KVM system GUI. The system returns a result based on the connections between the knowledge goal and the appropriate indicators. This result is then compared with the set value of the knowledge goal. In addition to representing the attainability of the goal, the result can also be used for methods such as the portfolio analysis. The biggest challenge of the valuation component is the linkage between goals and indicators. We principally identified three practicalities to connect both. First, the connection is selected by management. This is called the manual technique. Some advantages are exact pair finding, the involvement of relevant employees and a possible push for new ideas in knowledge management. On the other hand, some important disadvantages can be identified. The manual connection process is time-consuming and laborious. Furthermore, each change in the goal system entails a new internal meeting of all involved and possibly even external participants. The second opportunity can be termed a semi-automatic technique. Here, the valuation component realizes the linkage between goals and indicators by giving suggestions, which must then be approved by those responsible. The third way is full automation, essentially by employing the semi-automatic method without the subsequent user intervention. This approach requires a semantic process for tagging the elements and a validation process for the connections. The semi-automatic approach is currently regarded as most promising and will be explained in more detail below.

A formal description is necessary in order to be able to use goals and indicators in an automatic process. In the KVM system we use the XML standard for handling both elements within the architecture. As part of the semi-automatic matching technique, it is necessary to find the suggested indicators for a goal automatically. The basic concept is to match goals and indicators by comparing their keywords. Here, we present an elementary example based on figure 2. The goal "increase knowledge transparency" (g_1) has the keywords knowledge sharing (g_1k_1), socialization (g_1k_2) and externalization (g_1k_3). Possible indicators include "number of documents in a document management system" (i_1) with the keywords knowledge sharing (i_1k_1), externalization (i_1k_2) and "number of internal training courses" (i_2) with the keywords socialization (i_2k_1), meeting (i_2k_2). The indicators i_1 and i_2 are based on the assumption that knowledge can be shared through externalization with the help of information systems and socialization (Nonaka and Takeuchi, 1995). The more documents are accessible about topics relevant for the particular organization, the more employees have access to this knowledge. Likewise, the more internal training courses take place, the more knowledge will be shared in the company. One way to match both elements is to use an algorithm that compares the XML structured keywords and to connect the knowledge indicator and the knowledge goal based on the similarity of the keywords.

For this process a couple of techniques can be found in the literature (Rahm and Bernstein, 2001). Here, we will focus on the exact matching method where an exact comparison between the indicator and the goal takes place. An overview of schema matching methods can be found in Cohen, Ravikumar and Fienberg (2003). A more sophisticated approach is based on the Levenshtein distance (Levenshtein, 1965). This matching algorithm can be used especially for plural and singular problems or British and American English notation of keywords. The fewer edit string operations necessary, the greater the coherence between both. For the short example the above implies that the KVM system should connect g_1 with both indicators i_1 and i_2 only when using the Levenshtein matching algorithms. When exact matching is used, g_1 is only connected to i1. This simple example shows the principle matching process implemented in our prototype.

The main problem of the matching process is referencing the right keywords. This applies both to goals and indicators. It requires the use of a common language for descriptions in order to communicate meaningful on the topic of organizational knowledge. A vocabulary for the knowledge domain had to be created during the design of the KVM system. This is company-specific but general approaches can be used as a basis to minimize the creation effort. All keywords used have to be included in the vocabulary. For example, a knowledge ontology can be used as basis for the common language. The element con-onto represents the allocation of a knowledge goal to knowledge ontology. This is especially required for the fully automatic process. Ontologies are one possibility for solving the problem of a common language in the KVM system (Abecker and van Elst, 2009; Almeida and Barbosa, 2009; Zelewski, 2002). Davenport and Prusak (2000) argue that "…[p]eople can't share knowledge if they don't speak a common language…". The same can be said for knowledge management systems and especially for some of the automatic processing included in them. Elementary exploratory works do exist, however. Abecker and van Elst (2009) give a summary of ontologies for knowledge management with requirements and challenges. Jurisica, Mylopoulos and Yu (2004) argue that "ontologies are useful because they encourage standardization of the terms used to represent knowledge about a domain". This selection of literature shows the essential meaning of ontologies in knowledge management. One associated question reads: Is it useful to create a common knowledge ontology to handle the required vocabulary in different companies? In our opinion, such a solution can only be applied as a skeletal structure for specific company ontologies.

The next step in the valuation process is the calculation of the actual attainment of a goal. As with the matching process, several approaches can be found. The easiest way is to perform a calculation with the help of a linear equation. More sophisticated approaches are based on exponential or logarithmic functions. In particular, a logarithmic function can be used for goals which are attained at a high rate. Before using the KVM system the customization process requires a decision about the calculation method for goal attainment.

6 Prototype

The feasibility of the presented approach for knowledge valuation is demonstrated with the help of a prototype. Like the general system architecture, this prototype can also be divided into four modules. These include the interface to existing information systems in a company, the structured storage of information about knowledge, the calculation of the attainability of knowledge goals and the presentation of the results.

The core of the KVM system prototype is a relational database implemented in MySQL®. It represents the storage of information about knowledge which can be used for the valuation process. Therefore, it can be called the central access point to analyze the knowledge of an organization. The program logic is implemented using JAVA™ components. User access for the input and presentation at the GUI of the KVM system is implemented in JAVA Swing.

The software components approach was chosen for implementation within the KVM framework. Fundamental here is the definition of a component by Jed Harris. He describes a component as "…a piece of software small enough to create and maintain, big enough to deploy and support and with standard interfaces for interoperability…" (Orfali, Harkey and

Edwards, 1996). Similar to the principle of information hiding, which is known from object-oriented software development, the components described here hide their data and internal behavior like a black box. The reason for the use of software components was to assure the interchangeability of parts of the KVM system. Because of further developments in the knowledge valuation field, it was necessary to choose this component-based approach in implementation. For example, if the knowledge valuation process changes or is replaced with a different process, only one component actually has to be exchanged.

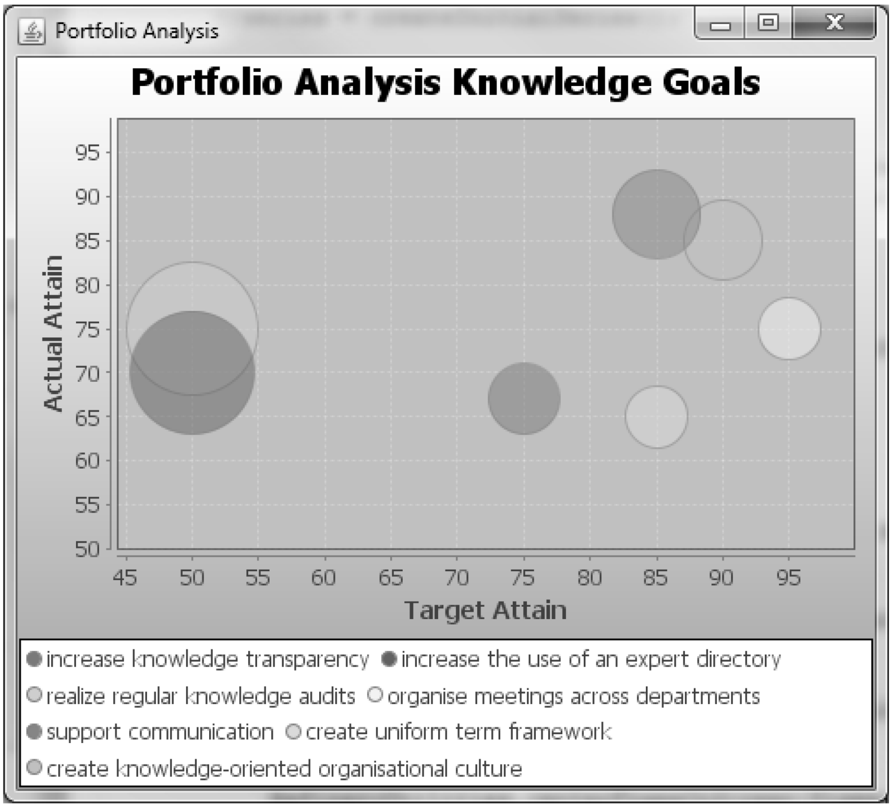

Figure 4. Portfolio analysis of the KVM system

Some features important for the subject of this paper will be explained now. The users of the KVM system can enter knowledge goals into the system using two different options. The first one is a simple text where the user can enter data concerning a knowledge goal, e.g. a name, connected indicators/goals or a goal target value. The second input option is to model the knowledge goals visually (like figure 2) with the help of an external software tool. In the first realization of the prototype we utilized MS Visio™ as a modeling tool for this purpose. All necessary information about a knowledge goal can be entered through the external modeling system. Because of the standardized XML interface of the KVM system, it is possible to connect different external systems here. We are currently integrating an additional modeling tool based on a fuzzy set theoretic approach.

Similar to the process for entering knowledge goals, information about the knowledge indicators is entered via a predefined form. However, in contrast to knowledge goals, indicators are connected to information in the database in order to calculate their actual value. A semi-automatic connection of indicators and goals with the help of an ontology is integrated in the system. The ontology is generated by the external tool protégé[3]. The ontology can be used through the XML interface of the KVM system. The interface from

[3] http://protege.stanford.edu/

the KVM system to external information systems in a company is implemented using two sample systems (a skill management system and a document management system). In the current prototype, the representation of results from the knowledge valuation process is implemented as a display of the attainment of knowledge goals. Figure 3 shows a portfolio analysis of the knowledge goals from figure 2 as an example of the visualizations in the GUI when communicating with the user. An improved dashboard and the integration of further methods such as a scenario analysis will be implemented in a future prototype version.

7 Conlusion and Future Work

Knowledge is an important resource in many branches of industry. The important aspect of strategic knowledge planning in organizations has not yet been solved satisfactorily. This includes the capturing of existing knowledge in an organization and its use for strategic planning as well as adequate support for the associated processes through information technology. This paper presented an approach for strategic knowledge planning with the help of knowledge valuation. Some central aspects of the developed KVM system relating to knowledge goals were highlighted. The proof-of-concept prototype demonstrates the general feasibility of the proposed KVM system.

In the future, different knowledge valuation approaches (e.g. Scandia Navigator) will be implemented in the prototype. Furthermore, the prototype will be extended and extensively evaluated with our industrial partners in case studies.

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