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Business Knowledge Development using Knowledge Maps

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ABSTRACT

Knowledge is widely recognized as a strategic factor to business success. Therefore, it has become increasingly important for the companies to develop their knowledge potential and to form the basis for long-term and sustainable competitive advantages. The companies have to be aware which knowledge they have and how the knowledge should be developed to meet the challenges of the future. In this context an approach that combines knowledge mapping and scenario technique to find strategies for company's knowledge development is presented. Knowledge mapping is a process of creating an inventory of the current knowledge and representing its distribution within a company. On this basis, and considering the impact of internal and external factors scenario technique is used to improve the state of knowledge. This results in developing target knowledge map. The difference between current and target knowledge structure allows deriving measures to close the gap and to exploit company's development opportunities. This paper highlights the importance of knowledge development for long-term economic growth and provides a description of an approach for achieving this objective.

Keyword: Knowledge Development, Knowledge Management, Knowledge Maps, Business Development, Business Strategy

1. Introduction

To survive and prosper in a highly competitive and rapidly changing environment, organizations need to develop sustainable competitive advantages (Mostert, & Snyman, 2007). The economies in highly-developed countries are increasingly based on knowledge and information (OECD, 1996). Knowledge is recognized as one of the most competitive resources for productivity and economic growth, leading to a new focus on its role in organization's development. Taking into account new challenges like, fast technological and social changes or shortened development periods, organizations that want to remain competitive have to manage their highly distributed knowledge. For this reason, it is necessary to identify essential knowledge that can improve the company's business process.

This paper presents an approach to link company's knowledge and factors that influence its development. The goal is developing a comprehensive concept that integrates company's knowledge and strategy development taking into account internal and external influence factors.

In order to achieve this objective a work program is launched. This program is broken down into two steps: 1) gathering and analysis of company's knowledge and knowledge sources, 2) strategic development of relevant knowledge domains considering the future scenarios and derivation of strategies for knowledge development.

The relevant knowledge domains will be derived from the analysis of company's intellectual capital. The distinguished knowledge domains should be examined to identify knowledge elements. To gather and to structure the knowledge elements with the same granularity a set of methods must be used. Thus, the knowledge elements on the same level of detailing and dependencies between them can be mapped. As result, a knowledge map that represents a topographical structure of knowledge within the analyzed knowledge domains can be created. The captured knowledge elements should be analyzed in context of internal and external factors of influence and used as the basis for constructing scenarios. According these scenarios knowledge strategies for the company can be estimated. Based on the determined knowledge strategy the target knowledge map will be developed. Both current and target knowledge structure will be compared and the need for action in form of concrete measures derived.

2. Knowledge Maps

A knowledge map generally consists of two parts: a ground layer that represents the context for the mapping, and the individual elements that are mapped within this context (Eppler, 2001). Business models, product portfolios, projects, department structures are examples for the ground layer. Depending from a concrete layer the individual elements such as roles of employees, components of a product, or explicit knowledge forms can be mapped.

The main objective of a knowledge map is to visualize the knowledge structure and shows the locations of knowledge related elements and their relations. A knowledge map is a visual display of captured information and relationships, which enables the efficient communication and learning of knowledge by observers with differing backgrounds at multiple levels of details (Veil, 1999). From this definition the goal for knowledge mapping can be defined. Knowledge mapping serves as both an instructional and assessment tool to illustrate both declarative knowledge (facts, definitions, statements) and to a lesser extent, procedural knowledge (how something is done, e.g., processes for problem solving, plans, decision making) (Chung, Cheak,

Lee, & Baker, 2012). According (Eppler, 2001) in a corporate context following types of knowledge maps can be used:

- Knowledge source maps: This type of maps structure a population of company employees along relevant criteria.
- Knowledge asset maps: These maps qualify the existing stock of knowledge within a company.
- Knowledge structure maps: This type of map outline the global architecture of a knowledge domain and the relations between the domain elements
- Knowledge application maps: These maps show which type of knowledge has to be applied in a specific business situation.
- Knowledge development maps: These structures depict the necessary stages to develop certain competences or skills within a company.

In our approach the business model and department structures within a company are used as ground layer. On this layer the knowledge-intensive structure of the company is depicted. As individual elements the roles of employees, their task and activities, single knowledge elements, and exchange flows are regarded. This kind of map we describe as knowledge asset map because it visualizes the existing knowledge of the individuals and provides an overview over company's intellectual capital.

3. Approach

To reach the goal as described above a working program was developed. This program is broken down into five working packages [figure 1]:

WP 1: Characteristics of company's intellectual capital and selection relevant of knowledge areas within the company.
WP 2: Preparation of cross-company's knowledge map.
WP 3: Development and selection of business strategies.
WP 4: Creating of future oriented target knowledge map.
WP 5: Concept of strategic knowledge development.

3.1. WP 1: Characteristics of company's intellectual capital and selection of knowledge areas within the company

The objective of first working package is 1) estimating of intellectual capital within a company and 2) identification of relevant knowledge domains. There are different classifications of intellectual capital. A widespread classification in German-speaking areas is one that differentiates between human, structural and relationship capital (Bischoff, Vladova, & Jeschke, 2011). Human capital is the knowledge, skill and capability of individual employees providing solutions to customers (Tapsell, 1998). Some of these knowledge elements are unique for the individuals and thus to the

company. Examples are professional expertise, know how, motivation, or social skills.

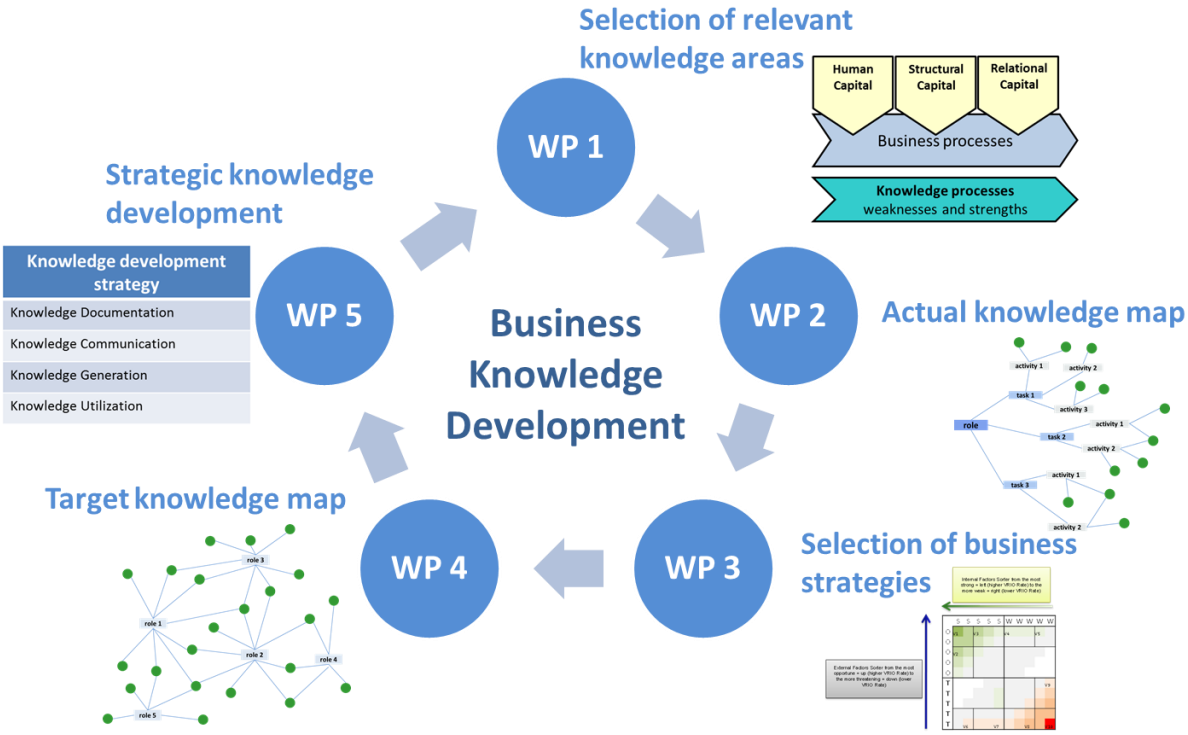

Figure 1. Approach for business knowledge development.

Structural capital is defined as the knowledge regarding the organizational structure. It comprises organizational routines, procedures, systems, or databases. An individual can have a high level of intellect, but if the organization has poor systems and procedures by which to track his or her actions, the overall intellectual capital will not reach its fullest potential (Bontis, 1994). This kind of knowledge is independent from the company's employees. This means that this knowledge remains in the company and is not correlated with the fluctuation of employees. Examples are internal communication, documented knowledge, company's culture, or management instruments. Relationship capital comprises capital generated by intra-company relations, primarily relations established among company's strategic business units, and relations between the company and its environment composed of consumers, suppliers, distributors, other business partners and relevant public (Djurica, Djurica, & Janicic, 2014). Examples are customer satisfaction or supplier loyalty.

The analysis of intellectual capital gives the first overview over the knowledge domains and their weaknesses and strengths within a company. Based on these findings the relevant domains could be analyzed in detail using knowledge maps. This method is explained in next section.

In our project, we use the ICS Toolbox for the estimating of intellectual capital. This toolbox was developed by Fraunhofer Institute for Production Systems and Design

Technology IPK. It based on Intellectual Capital Statement model shown in figure 2 and was implemented as a computer application.

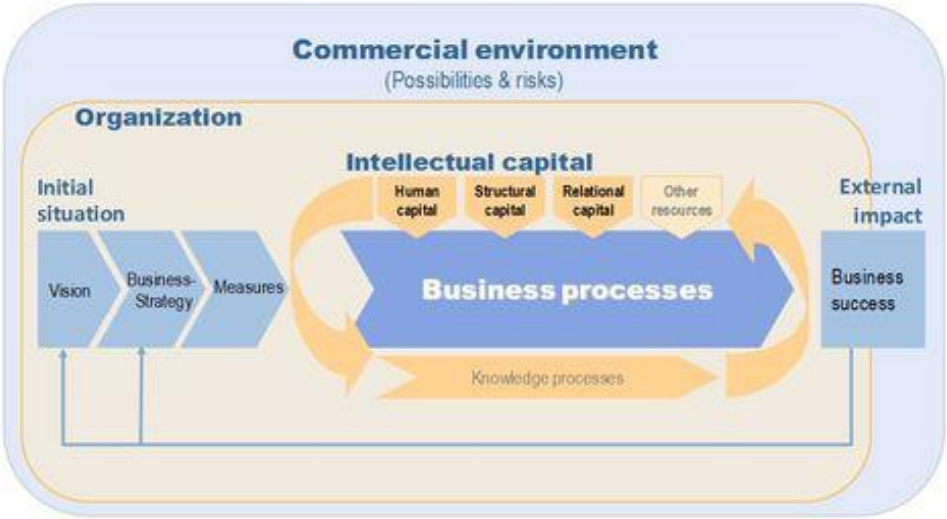

Figure 2. The ICS Structural Model according European ICS Guideline (www.incas-europe.org).

The software supports gathering of information, their interpretation, and compilation of intellectual capital reports. It allows the ascertaining of actual situation and gives a comprehensive overview (for example as portfolio) over knowledge potential within a company [figure 3].

Intellectual capital report helps us to specify the subject of consideration for the further analysis. Based on this report the most relevant departments, roles of employees and their tasks can be identified.

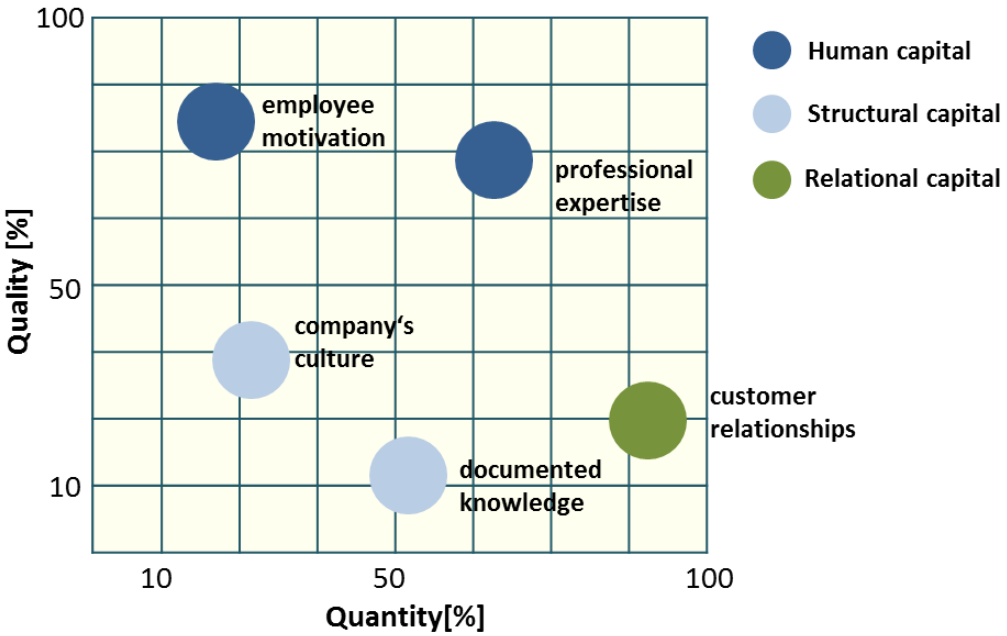

Figure 3. Intellectual capital depicted as portfolio.

3.2. WP 2: Preparation of cross-company's knowledge map

In this working package the findings in form of intellectual capital statement created with ICS Toolbox will be mapped on the knowledge relevant company's structure. As a basic structure we have chosen the company's departments. Within the company's departments we identify other assets related with knowledge distribution. Based on this overview we are able to identify the knowledge domains where the business-critical knowledge is stored or generated and the interfaces where this knowledge is exchanged. This constellation allows us to examine the existing assets and their relationships [figure 4]. Thus, we create a knowledge map that depicts the dependencies between knowledge assets regarding the organizational structure.

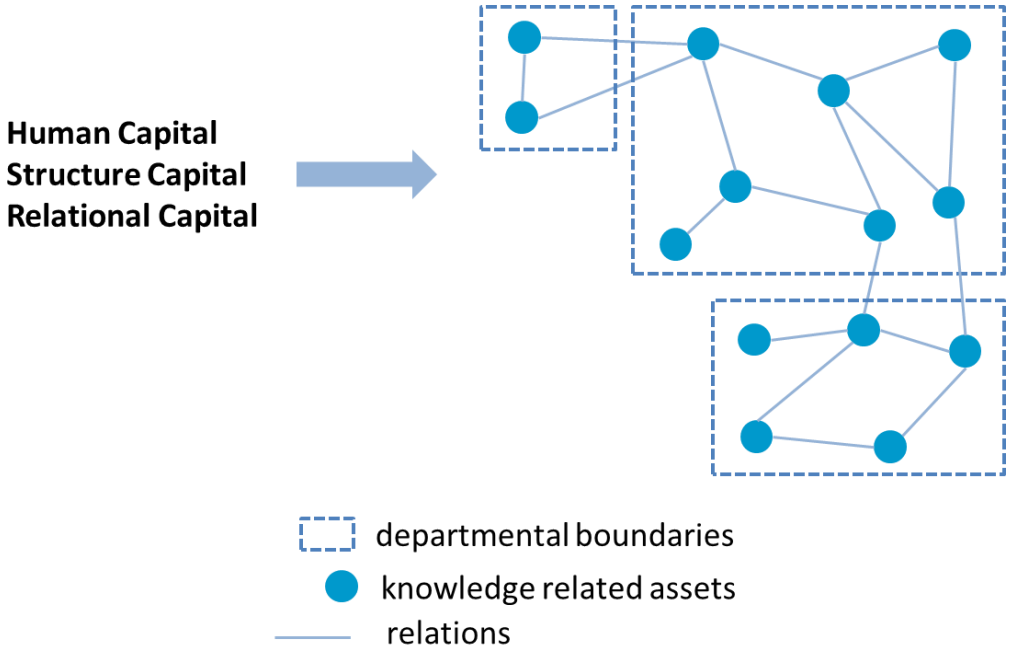

Figure. 4. Mapping intellectual capital using knowledge maps.

As knowledge related assets we have chosen the roles of employees, their tasks, their activities, and the knowledge elements that will be created or exchanged while the employees perform their tasks [figure 5]. The knowledge assets are connected because the employees are not able to fulfill their task independently. There are dependencies between roles, tasks, activities and knowledge elements. For example, task B cannot be completed before task A is fulfilled. These relationships are described by the knowledge flows.

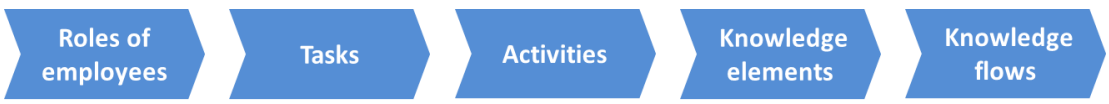

Figure 5. Knowledge related assets using for knowledge mapping.

In our approach we focus on the tasks that are important for the company's competitiveness. In this context the main challenge is to recognize the knowledge elements and estimate the knowledge towards development in relation to business strategy in the future.

The data for creating of actual knowledge map are gathered directly from the employees in two-phase approach. In the first phase, a common workshop with the employee representatives from the relevant departments is hold. During this workshop understanding of used terminology and understanding of granularity of knowledge assets can be reached. In the second phase, the participants in the workshop are interviewed and questioned regarding their individual assets [figure 6].

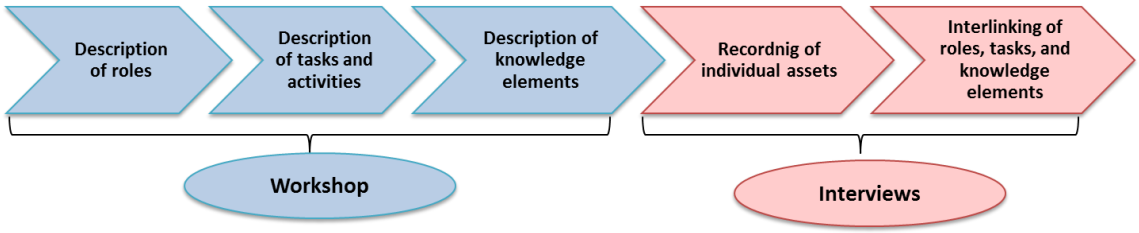

Figure 6. Two-phase approach for gathering of knowledge-related assets.

The interviews should be conducted with the employees that are responsible for carrying out knowledge-intensive processes that determine company's competitiveness. Each of the interviews is conducted according to the same guideline. As a result of an interview a knowledge map of an employee is created [figure 7a]. The maps of interviewed employees are summarized and a knowledge map of a department or of a whole company is generated [figure 7b]. Because of the high degree of complexity we omit roles and activities and focus on tasks of employees and their knowledge elements. Thus we create a graph that allows recognizing the most knowledge- intensive tasks and relationships between them within a knowledge domain.

This map depicts the actual situation and can be analyzed regarding strengths and weaknesses. In this context we consider human, structural, and relational capital on the very deep level of their being including the degree of networking, redundancies of knowledge elements, or employee-owned knowledge elements. The knowledge related weakness is for example the employee-owned knowledge elements that are unique in the company. If the employees leave the company, the company will lost with them a part of its intellectual capital.

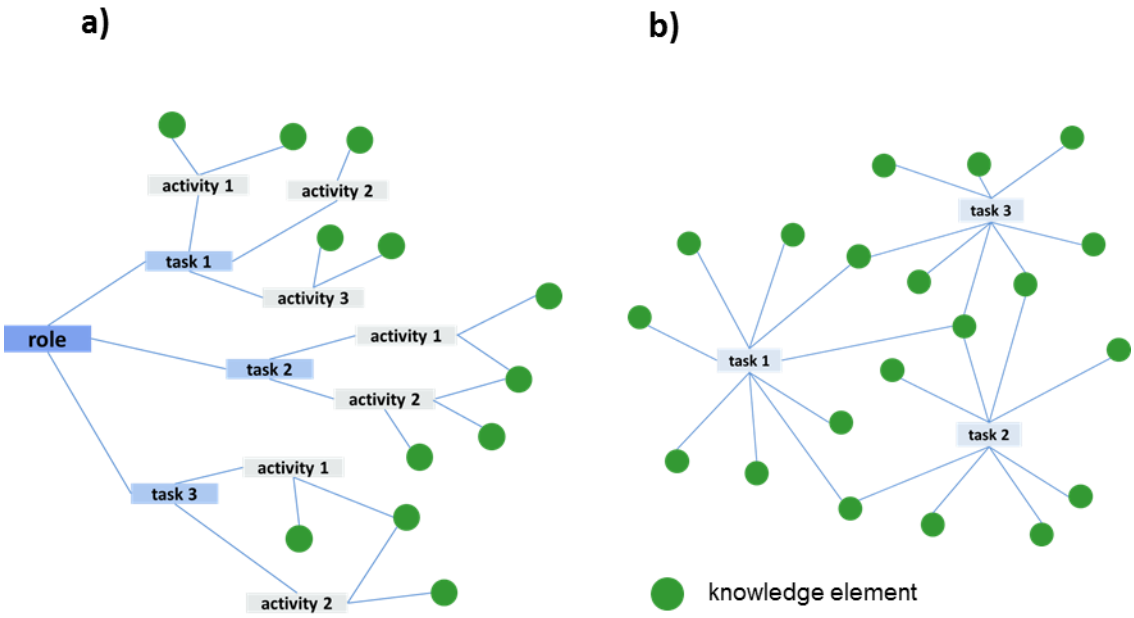

Figure 7. Knowledge map a) for an employee and b) for three employees.

In next step, the scenarios for the company development are factored and assessed. The data for the analysis of these scenarios will be gathered during the next series of interviews. These interviews will be conducted with company's representatives that are responsible for the strategic planning. Based on these interview results the best or most possible strategy for the future can be chosen. Regarding this strategy and the necessary knowledge development that allows realizing this strategy the chances and risks can be estimated. This analysis is depicted as target knowledge map. In last step the measures for reaching of desired knowledge level will be defined.

3.3. WP 3: Development and selection of business strategies

The business strategy can be defined as a set of actions that managers take to increase their company`s performance relative to rivals (Hill & Jones, 2009). A successful business strategy leads to competitive advantage. In order to carry out the actions to follow the business strategy, the company needs knowledge. If the current knowledge of the company is not sufficient to support the company's business strategy, the knowledge must be developed.

We developed a general procedure that allows the evaluation and comparison of business strategies in order to establish a transparent base for making a decision. This procedure based on the analysis of future scenarios in which the benefits of regarded business strategies are forecasted and compared [figure 8].

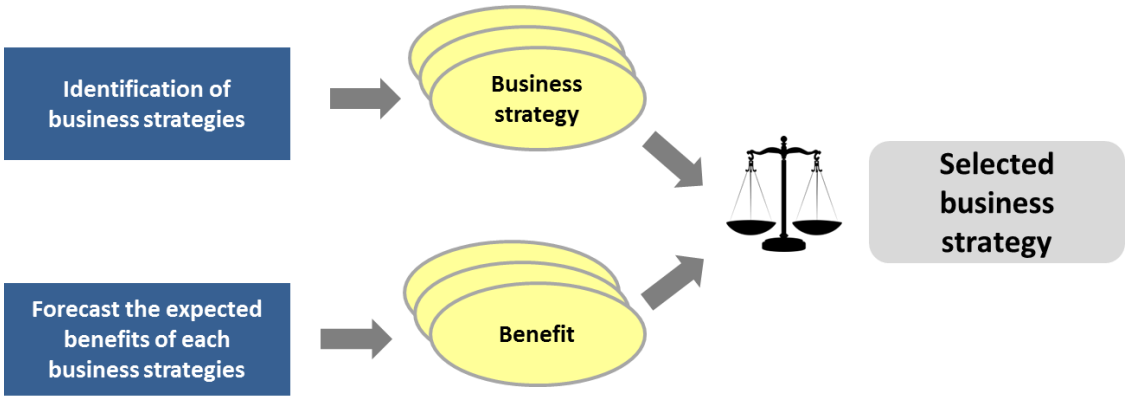

Figure 8. General procedure to select a business strategy.

Competitive advantage is influenced by both internal and external company factors. Internal factors are under company's control like product customization or geographical location. External factors like evolution of technologies or legislation cannot be control by the company. We analyze the status of contribution of those factors using the Internal Factor Analysis Summary (IFAS) and the External Factor Analysis Summary (EFAS) proposed by (Wheelen, & Hunger, 2011). The current contribution of internal factors to the company's competitive advantage using a VRIO framework is rated from 1 to 5. The VRIO framework proposes four questions to evaluate the company's competences (Barney, 2002):

- **V**alue: Does it provide customer value?
- **R**areness: Do any other competitors possess it?
- **I**mitability: Is it costly for any competitors to imitate it?
- **O**rganization: Is the company organized to exploit the resource?

The influence of external factors is assessed from 1 to 5. Internal factors represent strengths to be further exploited or weaknesses to be solved. External factors represent opportunities to be taken or threats to be avoided. **S**trengths and **W**eaknesses, **O**pportunities and **T**hreats are depicted in a SWOT matrix. In order to make more systematic the identification of possible business strategies, we propose a SWOT matrix that contains five most extreme-rated factors per category and in which potential business strategies are selected [figure 9].

Once the potential business strategies are identified, the expected benefits obtained from implementing each one of them are forecasted. Benefit is measured as the ability of the business strategy to generate a competitive advantage.

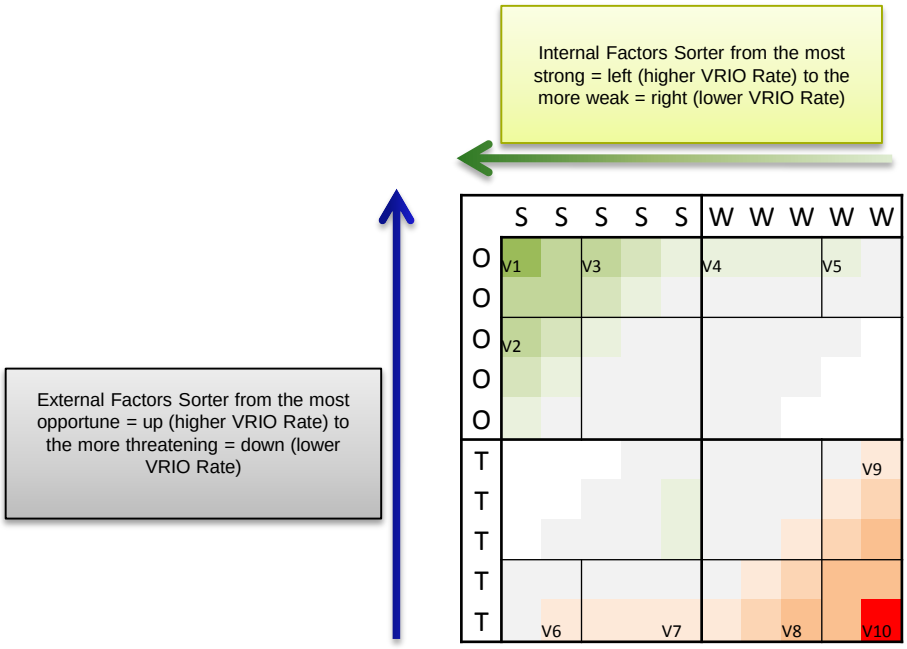

Figure 9. SWOT matrix to determine possible business strategies.

A competitive advantage is generated by four parameters: efficiency, quality, innovation and customer responsiveness (Hill, & Jones, 2009). The influence of internal and external factors on the parameters of competitive advantage per business strategy is assigned. A Monte Carlo Simulation is conducted to establish different future scenarios for the success of a business strategy. The main advantage of the simulation is the possibility of representing future uncertainty, what makes the result realistic. Input for the simulation is yearly forecasted for the evolution of internal and external factors that are defined in triangular distributions. The expected status of the elements of competitive advantage at the final time is represented in form of probability distributions [figure 10].

In order to reduce the effort for analysis, only some business strategies will be considered for further analysis. The selection criteria left open to the executive manager, who should focus on maximizing the parameters that are the most important for the company.

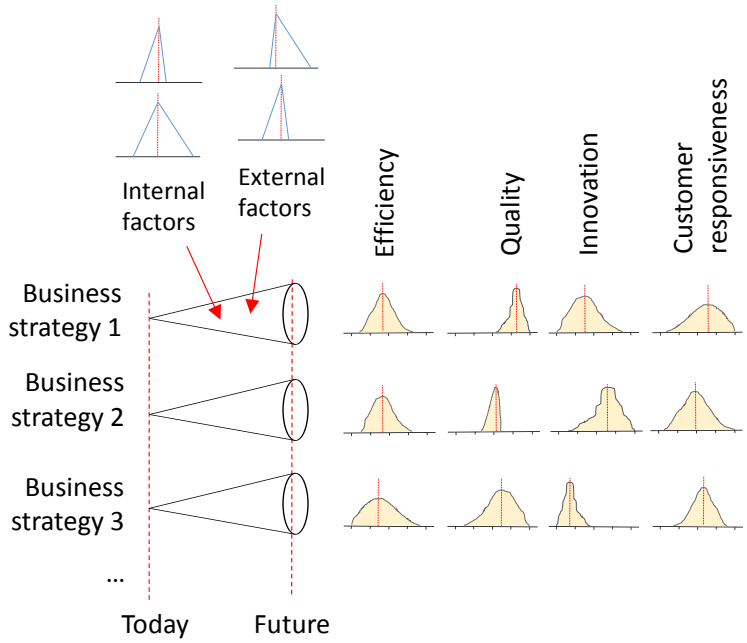

Figure 10. Scenario forecasting of the generators of competitive advantage for the potential business strategies.

3.4. WP 4: Creating of future-oriented target knowledge map

In this working package a target knowledge map is set up. It is based on the actual knowledge structure. This means that the individual components from the actual map will be found on the target map. This procedure makes possible the comparison of both knowledge structures. The input for creating of target knowledge map is derived from the selected business strategy and transferred on the actual knowledge map [figure 11]. Thus, new knowledge structure will be created and some elements will be either added or removed. This structure depicts the company's knowledge in the future and serves as a basis for consideration of appropriate measures for knowledge development.

3.5. WP 5: Concept of strategic knowledge development

The results of the analysis of business strategies and the analysis of knowledge strategies are put together as a base for decision regarding company's knowledge development. Therefore the requirements for knowledge development according a selected strategy must be determined. For this purpose, the target knowledge map is reviewed looking for affected nodes. The tasks within the company are reviewed at the first place. It is determined if the business strategy implies a task modification, task elimination or the addition of new tasks. Then, the knowledge associated to the affected or new tasks is determined.

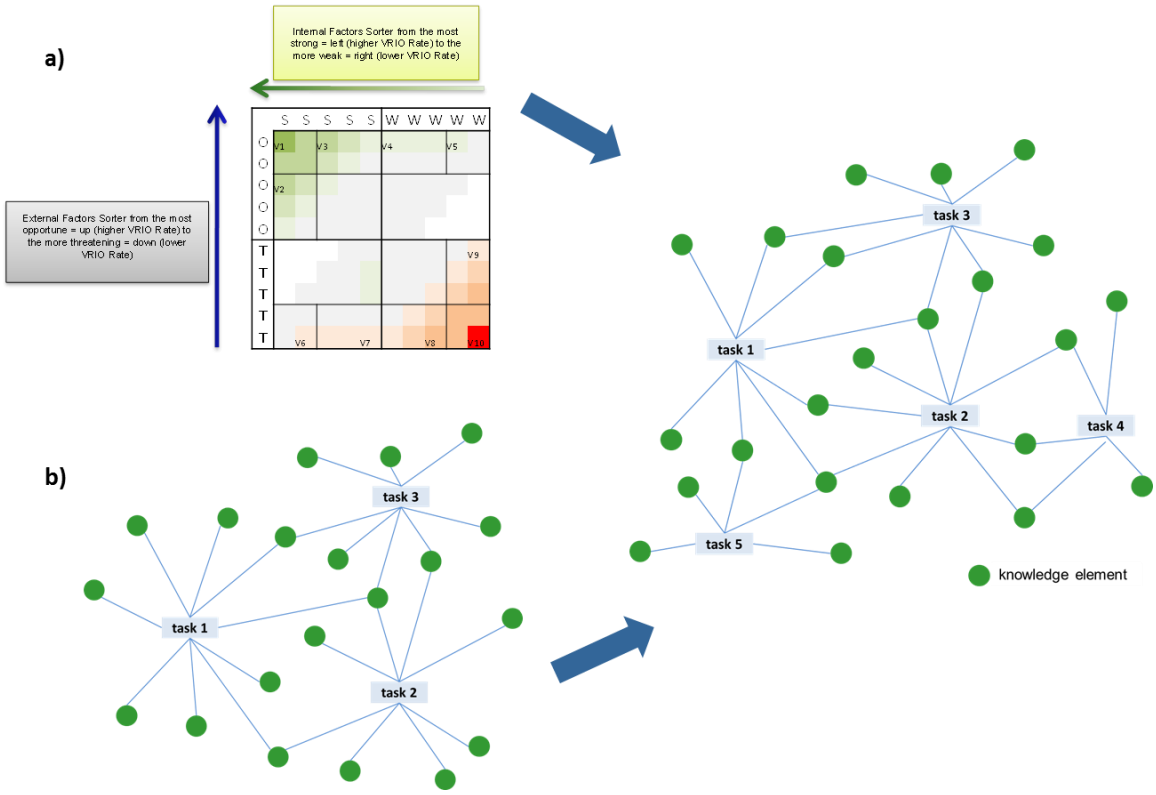

Figure 11. Target knowledge map is based on a) business strategy and b) actual knowledge map.

There are four strategies for developing the knowledge within a company (Gretsch, Mandl, & Schätz, 2011):

- Knowledge Documentation
  The existing knowledge must be made transparent within the company. The presentation of knowledge forms the basis for its communication. As an aspect of knowledge documentation we see also elimination of obsolete knowledge elements. The documented knowledge structure must be responded to the actual company's needs.
- Knowledge Communication
  It includes methods for sharing and disseminating knowledge so each employee has access to specific knowledge that is necessary to fulfill his tasks.
- Knowledge Generation
  To remain competitive and meet the challenges in the future new knowledge must be generated within the company or acquired from external sources.
- Knowledge Utilization
  The processes of knowledge documentation, communication or generation cannot ensure that the knowledge will be applied in practice. It is necessary to apply knowledge for solving problems and show its positive effects in form of best practices or lessons learned.

The appropriate strategy for knowledge development must be based on the actual situation within the company and the predicted future changes. Each strategy is realized by methods that have to be implemented in the company. We have created a list of methods for knowledge development that support each strategy [table 1].

Knowledge development strategy	Methods
Knowledge Documentation	wiki, databases, …
Knowledge Communication	coaching, job rotation,…
Knowledge Generation	creativity workshops, learning,…
Knowledge Utilization	best practices, lessons learned,…

Table 1. Extract from the list with methods for knowledge development

In each case, we consider the requirements for knowledge development and assign a suitable strategy and method to cover the determined needs. The decision making is based on the algorithm [figure 12]. Once the knowledge strategy has been determined, the adequate method is selected from the list in discussion with an executive manager.

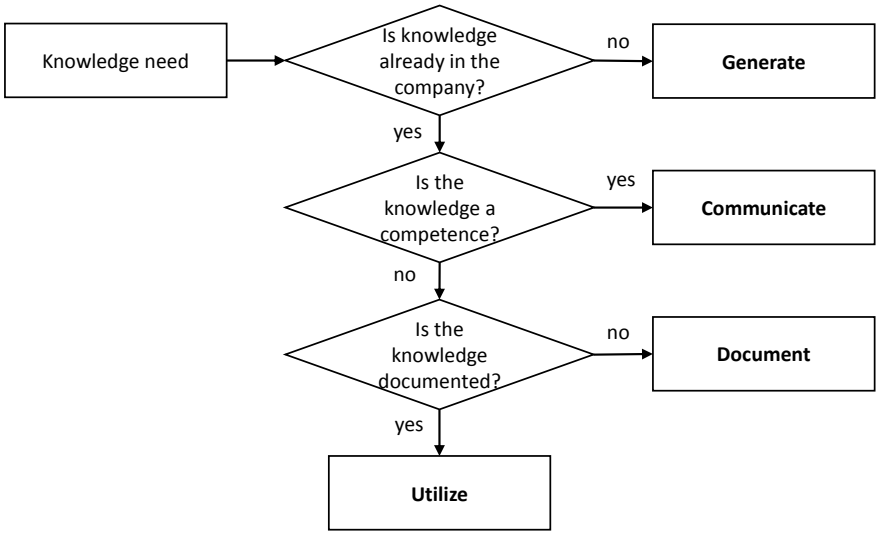

Figure 12. Algorithm for decision-making towards a knowledge development strategy.

Then, the efforts for the company in monetary terms of implementing the selected methods are estimated based on expected efforts acquisitions (working time, software licenses, hardware, etc.).

4. Conclusion and Outlook

In this paper we present an approach for business knowledge development using knowledge maps. This approach bases on a number of tools that allows selecting a set of knowledge development measures. These measures are selected on the actual

situation in a company and on the future challenges that the company has to meet to remain competitive. Future research will focus on implementing this approach in engineering companies and evaluating with the data from the case studies. Besides of suitability of this approach in real situations the development of software tools that can support data elicitation, interpretation, and selecting process will be regarded.

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