INTERNATIONAL DESIGN CONFERENCE - DESIGN 2012
Dubrovnik - Croatia, May 21 - 24, 2012.

PROCEDURE FOR DERIVING A TARGET KNOWLEDGE-BASE FOR COMPANIES TO EVALUATE KNOWLEDGE FOR PRODUCT DEVELOPMENT

D. Roth and H. Binz

Keywords: knowledge management, knowledge evaluation, knowledge identification, knowledge structuring

1. Introduction

"Utilising knowledge accumulated in an organisation can be a strategic weapon to acquire a competitive advantage" [Suyeon 2003]. Based on this or other statements, it can be concluded that knowledge represents an essential factor for companies. But realising that "knowing what one knows, and knowing when and how to use it, is an important component of expertise" is not really new [Chen 1993]. However, this insight gains new importance for current companies, striving for an increased competitiveness in extremely dynamic and complex markets.
For this purpose, knowledge as a result of combining information with specific context must be transferred target-oriented to value-added processes. On this occasion, to identify, to understand, to evaluate as well as to manage the knowledge, are necessary components in modern business cultures. The attempt to extend a company's competitive edge can be seen to some degree in modified rating systems. Companies find themselves confronted with the task of evaluating knowledge as well. 'Intellectual Capital Reports' offer an approach by dealing with representation and development of intellectual capital (knowledge) specifically.

2. Problem statement and goals

This contribution can be grouped into the area of knowledge management, especially in the domain of evaluating knowledge within the product development process (PDP). To evoke the aforementioned intellectual capital reports, it must be noted that these usually focus on three dimensions: human capital, structural capital and relational capital – various alternatives have arisen. Focusing on one of the essential resources of product development (PD) specifically, the product development knowledge (PDK) itself, those reports do not offer an adequate procedure for the evaluation and development of this knowledge [Roth 2010].
As a consequence, a method for evaluating knowledge within the product development process based on the opportunities of present approaches for knowledge evaluation needs to be developed. Knowledge represents a significant factor of the PDP and in the case of absence, induces missed business and product objectives. Corresponding to this assumption, the overall hypothesis for the project has been derived as: "the 'correct' knowledge at the 'correct' time at the 'correct' location in the required form and quality contributes significantly to the enhancement of the success of companies' products in the PDP".
Being aware of existing knowledge gaps in the PD allows target-oriented development of relevant knowledge. To gain a better understanding of the overall project in general, and to illustrate the role of

this contribution in this project in particular, the underlying overall project will be presented in brief (see also Figure 1).
Regarding the hypothesis, two areas of action can be derived: the need to capture PDK as well as the evaluation of it. The method for evaluating knowledge within this project follows certain steps according to the basic model of knowledge management development by Probst [Probst 2006], e.g. knowledge identification or knowledge sharing / use. Figure 1 describes these steps and represents the flow of knowledge by arrows within the evaluation and development process. The evaluation of knowledge in the PD requires unique characteristics to avoid mismatches. Therefore, a general structuring model (GSM) of knowledge within the PD has been developed [Roth 2010]. Specific knowledge types for the PD are classified within the product development process by Pahl and Beitz [Pahl 2003]. This product development process can be found in similar form in many other design theories. The approach to structure knowledge is a logical consequence of the fact that the detection of an object requires the explanation or the definition of the object. In a further step, the method should offer possibilities to identify and to acquire the actual knowledge within the PDP in companies (e.g. by developing suitable questionnaires – not discussed in this contribution).

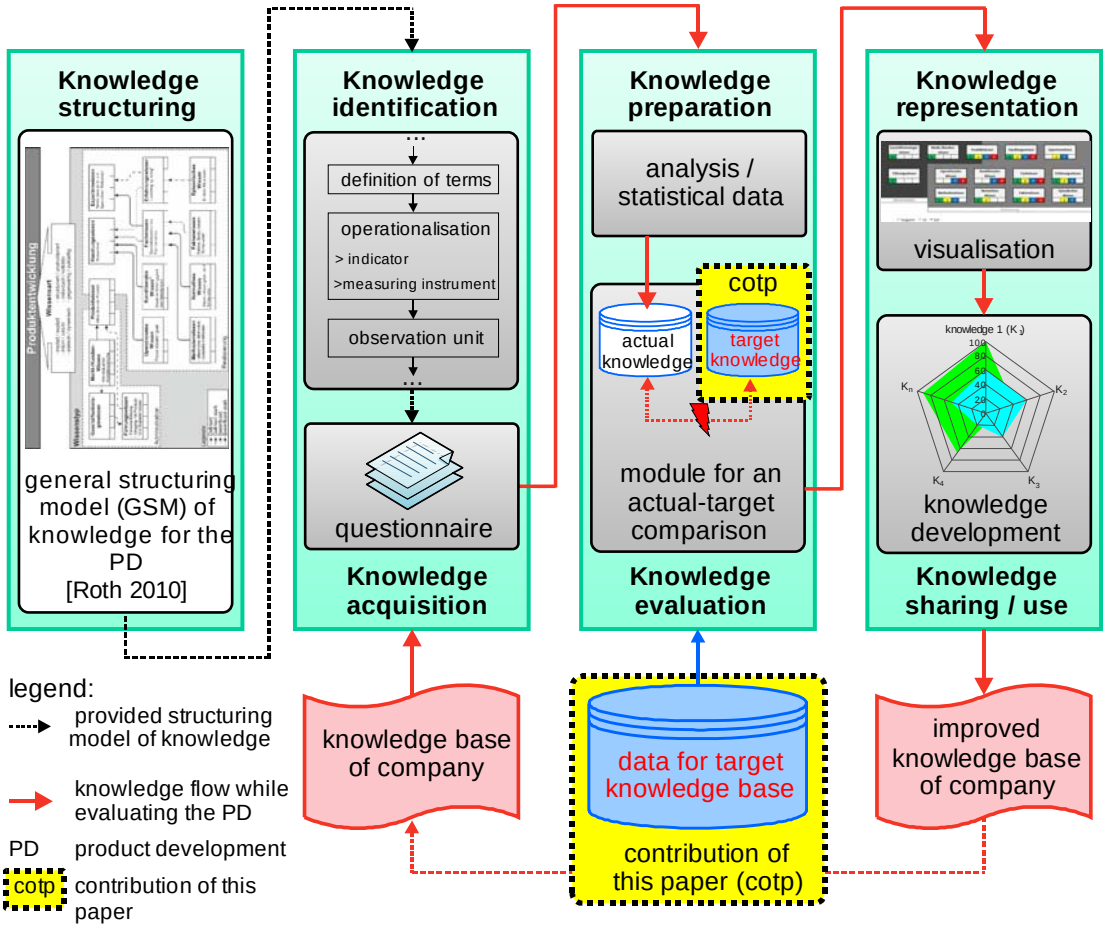

Figure 1. Overall project and related integration of this contribution

Nonetheless, the awareness of the actual knowledge is insufficient for providing a statement as to whether the necessary knowledge exists. Therefore, the actual knowledge base must be compared with the target knowledge base. This aspect has not been adequately considered in previous approaches. In general, they demand the disposition of knowledge, while they do not specify how and in what form this should occur. Though there is a variety of taxonomies as stated e.g. by Kakabadse [Kakabadse 2003] and the importance has been recognised, that "knowledge is an asset (… that) has to be managed" [Kakabadse 2003], no unique statements exist concerning the 'parameters' of this knowledge. This means that current approaches are not appropriate for adapting the necessary

knowledge base of companies to several factors such as the strategy, environmental influences or even the branch the product is placed in. The identified niche insists the approach to derive a specific target knowledge base for companies within the PD. With respect to the proposed overall project "evaluation of knowledge within the PDP", the target knowledge is based on the generic structuring model and must be reduced with respect to influencing factors such as the strategy or the branch. The development of a method for evaluating knowledge offers the opportunity to compare the actual knowledge with the target knowledge in companies for identifying existing knowledge gaps. The resulting potential in developing the knowledge contributes in the long run to an enhanced competitiveness of companies.
Resuming this chapter and summarising the motivation and problems as stated, the goal of this contribution is to offer a possible procedure for deriving a target-oriented knowledge base, related to a formerly developed general structuring model of knowledge within the PDP. As a consequence, the resulting knowledge base will be on a lower level of complexity to the superior GSM. The awareness of the knowledge gap between existing knowledge and this target-oriented knowledge allows a purposeful development of this resource.
The paper is organised as represented in Table 1. In addition, Table 1 contains the main research question (MRQ) and corresponding sub-questions (RQ1/RQ2/RQ3) that should be answered within this contribution to address the aforementioned problems and goal.

Table 1. Overview of the contribution and corresponding answered research questions

S = Section	(M)RQ = (Main) Research Question	
S 1		Introduction
S 2		Integration of the results of this paper in the overall project and contribution of this paper in detail – Problem and goals
S 3	MRQ	Clarifying the task: "How does a procedure for extracting an adequate target knowledge base within the evaluation of product development knowledge look and is the use of a semantic network appropriate for representing specific knowledge types within this procedure?"
S 3.1	RQ1	Is it possible to represent all identified knowledge types within the GSM by a semantic network – what are possible criteria for that decision?
S 3.2 S 3.3	RQ2	How to build up a semantic network with respect to RQ1 & RQ3 – what are the necessary steps?
S 3.3	RQ3	Which parameters influence a company's knowledge base and can these factors be used to adapt the GSM to a specific structuring model (= target knowledge structuring model)
S 4		Discussion of the results
S 5		Conclusion and outlook

Based on the main research question, a hypothesis can be formulated: "By means of several influencing factors (e.g. the corporate strategy, the branch, environmental restrictions, …) it is possible to derive a target knowledge structuring model (TKSM) from a general structuring model of knowledge within the PD that identifies only the relevant knowledge items for a specific application". The resulting TKSM represents a reduced part of the GSM ('fit for purpose').

3. Procedure for deriving a target knowledge base

A procedure has been developed for answering the main research question (see Figure 2).
Moreover, Figure 2 illustrates the main idea of this contribution and allocates the research questions from Table 1 to their related steps within the procedure. Based on the GSM, the idea is to represent all knowledge types (K_n) of the GSM by a semantic network, as for example methodical knowledge. Research question 1 attempts to clarify whether this is possible and what the limitations are. Receiving a semantic network for those knowledge types K_n allows the reduction of the GSM towards a TKSM, by taking constraints of companies into consideration. Research question 2 offers a brief guideline for

building up such a semantic network in this context. Research question 3 identifies possible constraints that may influence the GSM. As a result, the reduction will be examined with the aid of a brief example.

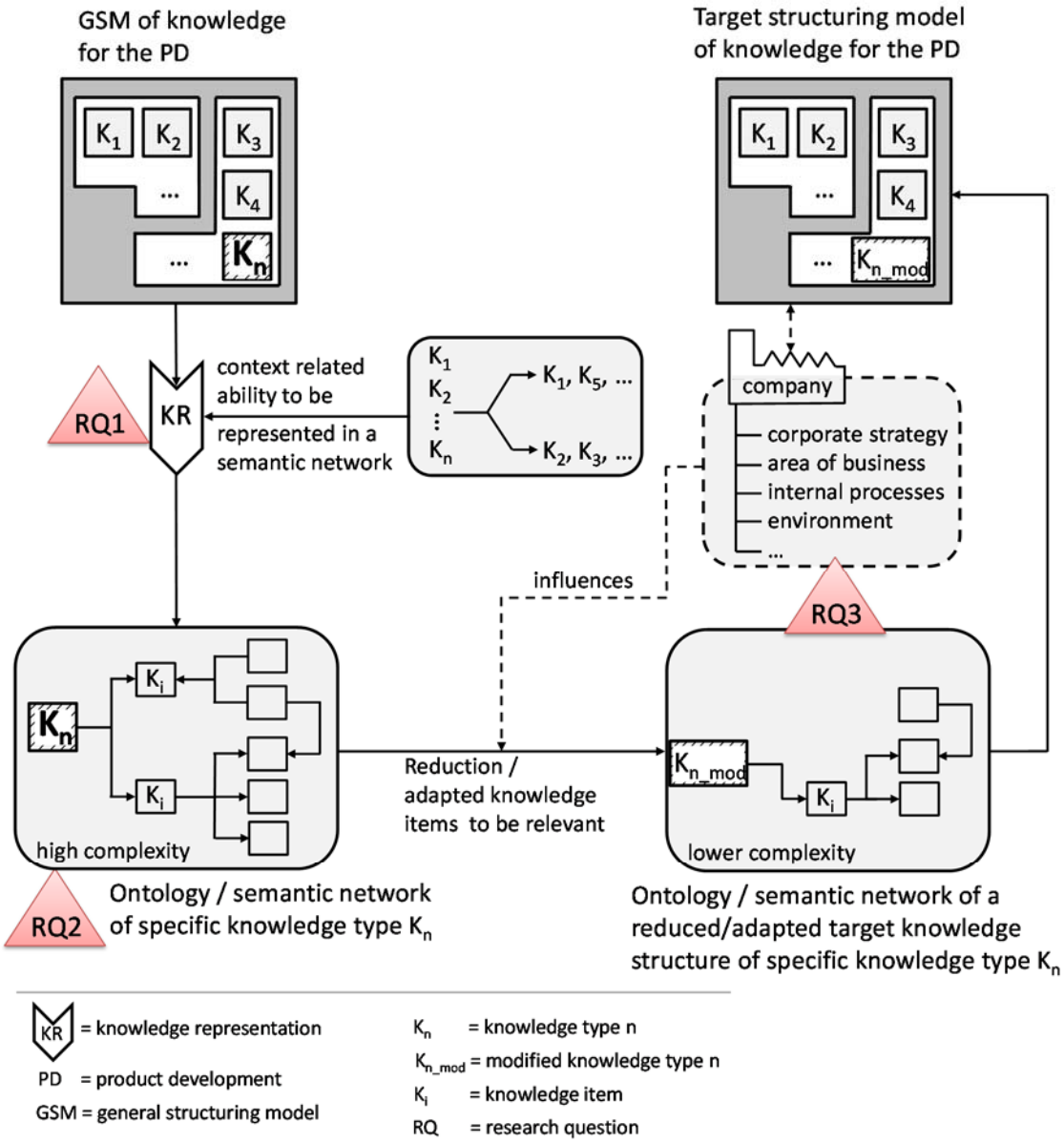

Figure 2. Main idea of this contribution in detail – Procedure

3.1 Answering research question 1

Structuring the knowledge items is an essential component for future capture and evaluation of knowledge within the PD. Present knowledge in companies can be acquired with the resulting structure and be checked with regard to completeness. In this context, it should be noted that those knowledge structures cannot entirely visualise the whole knowledge within the PDP. Only with the attempt to reach a detailed elaboration of these structures as well as the constant extension of these contents is it possible to achieve near completeness. The comparison of these structures with a target state permits statements about the current state.

The reduction of a superior structure towards relevant knowledge items in specific applications (‘fit for purpose’) reduces the necessary effort during acquisition and evaluation. To achieve this reduction, the knowledge types have to be represented in semantic networks (as aforementioned in Figure 2).

Whether all knowledge types out of the GSM can be represented in semantic networks or if not, and what the limitations are, will be discussed in the next section. In order to identify structurable knowledge types (structurable with respect to a permissible effort within the overall project), the characteristics of those knowledge types will be carried out in the following.
Previously, the terms knowledge and information (understanding in this contribution) must be defined and clearly distinguished as a necessary condition for the following theoretical considerations. In accordance with Lindemann [Lindemann 2008], information can be understood as data linked to a specific context. Knowledge is regarded as a meaningful linkage of information. Another perspective on this subject is chosen within this contribution. Based on Zboralski [Zboralski 2007], knowledge can be seen as a summary of all skills and all qualifications enabling problem solving processes. Furthermore, the information technology understanding summarises knowledge as the conjunction of data and information. Unlike many other approaches, the goal is not to carry out a discreet distinction of knowledge and information, but rather to handle a continuous transition from information to knowledge in accordance with Probst [Probst 2006]. The degree of transition depends on the peculiarity (linkage intensity) with regard to the relational context. Consequently, there will be no strict distinction between information and knowledge in this paper, but instead concerning the contextual relationship of each knowledge type.
This modified understanding of knowledge offers the possibility to distinguish the formerly mentioned knowledge types K_n of the GSM (see Figure 2), regarding their contextual relationship. As introduced above, the structurable knowledge types should be determined. This takes places by defining characteristics for classifying the knowledge types. Five characteristics have been developed in accordance with the general definitions of information and knowledge (see Table 2).

Table 2. Characteristics depending on the contextual relationship

Characteristics with **strong** contextual relationship			Characteristics with **weak** contextual relationship	
Characteristic	Property		Characteristic	Property
level of explicitness	low		level of explicitness	high
externalisation	limited		Externalisation	high
application orientation	high		application orientation	low
degree of crosslinking	high		degree of crosslinking	low
complexity	high		Complexity	low

Related to their properties, a superior distinction between “strong” and “weak” contextual relationships has been applied. Knowledge with a strong contextual relationship may hinder structuring knowledge due to the fact that it cannot be represented regardless of application. Decoupling knowledge from its context induces unspecific knowledge items (often referred to as information), easy to represent and assignable to the PDP.
The mentioned GSM in Figure 1 for example, consists of 14 knowledge types and offers specific descriptions of each knowledge type [Roth 2010]. With regard to these descriptions and the comparison with the characteristics provided in Table 2, it is possible to identify those knowledge types which can be structured (and thus be represented). Table 3 represents this classification.
Referring to the formerly assigned research question, it can be stated that it is possible to represent knowledge types within the PDP with a weak contextual relationship. This means that specialised knowledge, market/customer knowledge, methodical knowledge, product knowledge as well as factual knowledge (see Table 3) can probably be structured in that way, that they can be represented in a semantic network. The evidence will be presented in the following sections. As a limitation to this procedure, it must be noted that it is not currently possible to represent knowledge types with a strong contextual relationship with semantic networks within the overall project (with respect to the effort).

Table 3. Classifying knowledge types with respect to their context relation

Weak context related knowledge types		**Strong** context related knowledge types
		(non structurable knowledge types – present state)
specialised knowledge		business strategy knowledge
market/customer knowledge		expert knowledge
methodical knowledge		practical knowledge
product knowledge		normative knowledge
factual knowledge		episodical knowledge
		operational knowledge
		experience knowledge
		management knowledge
		conditional knowledge
knowledge types as defined in [Roth 2010, Binz 2011]		

3.2 Answering research question 2

On the way to derive the target knowledge-base, the next step consists of deducing the semantic network. For this purpose, the procedure in this contribution is based on a proposal for a practical methodology for capturing and representing organisational knowledge, presented by Suyeon [Suyeon 2003]. By defining a six step procedure, the authors finally strive to create a knowledge map by transferring certain aspects of knowledge into a graphical form. This procedure has been applied to the requirements within this paper (see Figure 3) while representing the specific knowledge types with a weak contextual relationship (see Table 3).

User-friendliness and the usability of knowledge structure models declines with increasing scope and complexity as mentioned in Section 2. Therefore, an essential objective of this contribution insists on generating knowledge structures which can be reduced by several influencing factors (remember Figure 2) to reduce complexity. With respect to the overall objective to evaluate knowledge within the PDP, a more superficial representation is considered as sufficient. The refinement of those structures represents a separate task in the future of this project. At the present state, they represent only the initial point for future comprehensive knowledge acquisition.

Referring to the first step on the left-hand side in Figure 3, the taxonomy (knowledge type, character, location, form, quality [Roth 2010]) and the knowledge definitions (general structuring model (GSM) out of [Roth 2010] have been compiled (detail level suitable to the overall project) in order to analyse the situation (second step) and to extract relevant literature (third step) in this area. Literature has been selected referring to the knowledge types to be represented. As explained above, it can be assumed that the selected sources can represent those knowledge types, but not exhaustively – but this is not the focus applied in this contribution. Steps four and six have been skipped for the chosen example within the procedure (should be proven later), only the fifth step is in accordance with Suyeon [Suyeon 2003] of further importance. Considering the rules for creating a semantic network, an excerpt of a semantic network for specialised knowledge can be seen in Figure 3.

Reflecting research question 2, an answer could be presented for the question “how to build up a semantic network” within this project. The necessary steps have been explained and an excerpt of a specific knowledge type with a weak contextual relationship has been developed as an example.

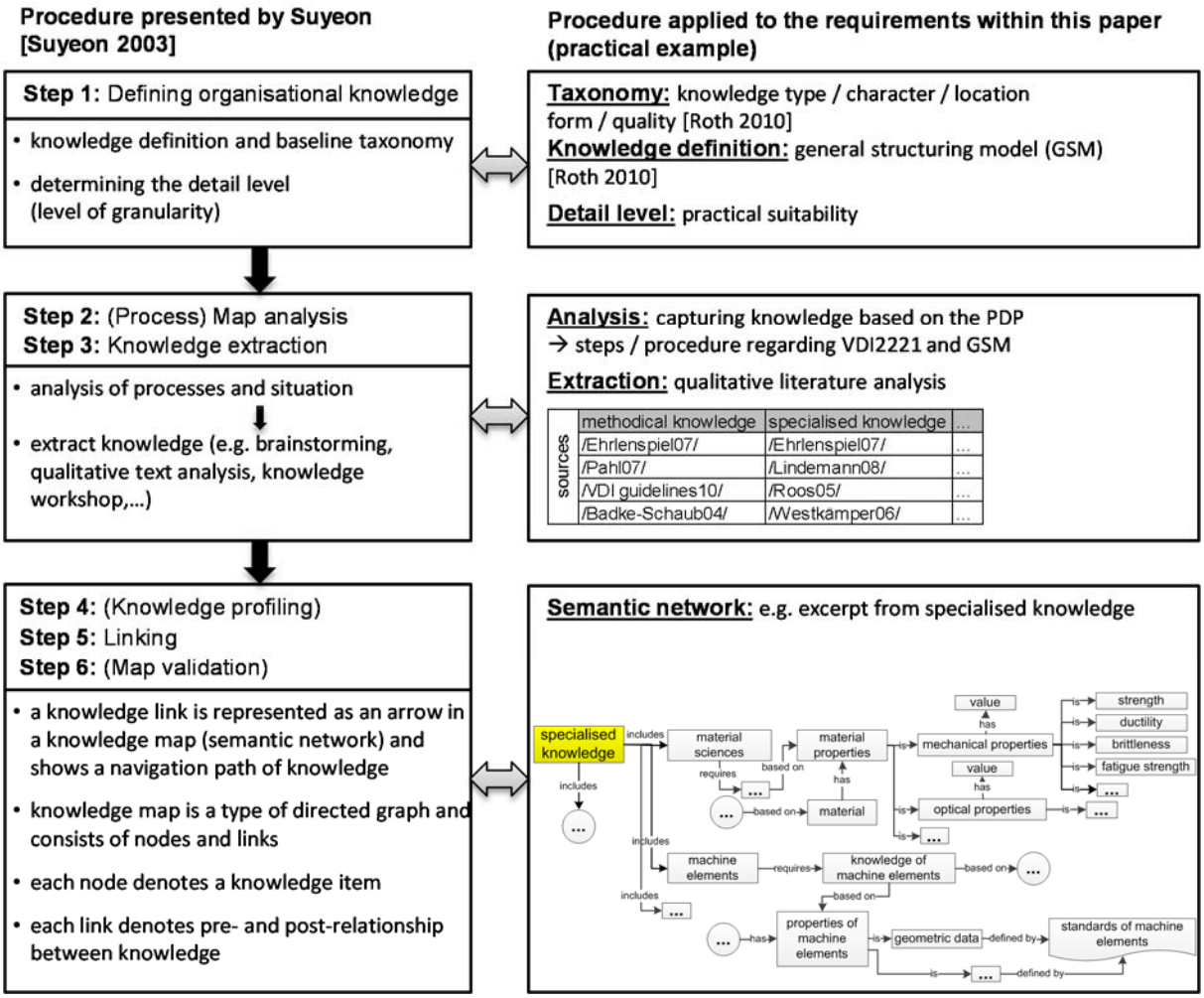

Figure 3. Deriving the content for a semantic network of a specific knowledge type K_n

3.3 Answering research question 3

The following section links the theoretical basics that have so far been presented in this contribution. Knowledge types with a weak contextual relationship have been determined and a procedure for developing the notation of these knowledge types has been introduced. As mentioned previously, as also depicted in Figure 2, several constraints of companies influence the applied knowledge structure. The research question of "which parameters influence companies and if these factors can be used to adapt the GSM to an adapted structuring model" offers a wide spectrum of answers. Dealing with the first section of the question, it can be stated that in the full range of results, it is not possible to reliably identify all influencing parameters of companies. Keeping the focus on the product development process, it is obvious that these constraints must also deal with the knowledge types within the PDP. More detailed scientific studies are also needed. Nevertheless, first influencing factors can be named – referring to a first literature analysis and expert discussions: the corporate strategy, area of business, internal processes as well as environmental restrictions.

In this contribution, the corporate strategy represents the chosen factor for the reduction of the GSM towards the desired TKSM. For representation of the corporate strategy within the knowledge structure, two procedures appear useful. For one, it is possible to assign discreetly defined corporate strategies and modified structures for the product development knowledge. The knowledge structure can be modified by a reduction or extension of distanced or grouped knowledge items. On the other hand, a strategic alignment of the company can be captured by defined parameters. Thereby, the strategy becomes operationalised and can also be described. The parametric conception of the corporate strategy offers the possibility of assigning several knowledge items. As a result, the structure

can be modified continuously. By way of example, the two different procedures are represented in Figure 4. This paper investigates the discreet allocation of the strategy to the knowledge structure.

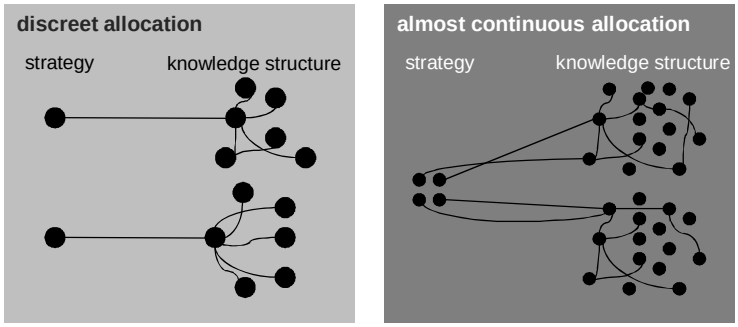

Figure 4. Assigning corporate strategy to knowledge structure

3.3.1 Discreet allocation of the corporate strategy to the knowledge structure

Based on the results of a brief literature analysis conducted on the influencing factors mentioned in the previous section, the options for describing the corporate strategy are the following parameters: time of 'market entry', the 'costs of products' as well as the 'benefits of products'. The discreet allocation of a corporate strategy requires the description of these strategies with regard to the formulated parameters. For this purpose, Figure 5 assigns the maximum characteristics of possible strategies within the scope of business action.

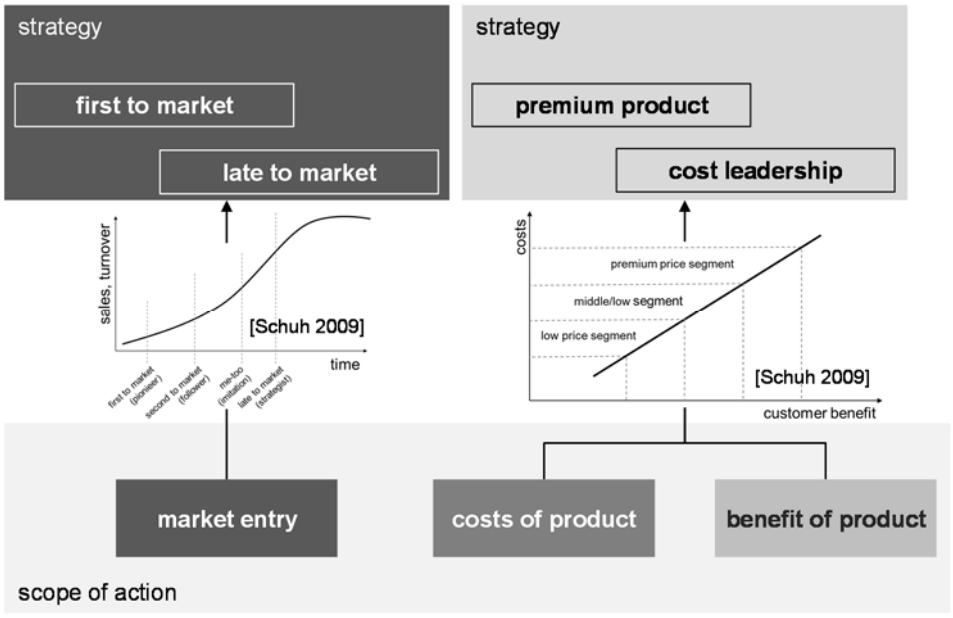

Figure 5. Discreet product strategies

It is possible to identify four essential corporate strategies (extremes). Proceeding from the chosen point of market entry, the strategies 'first to market' and 'late to market' arise. The correlating product costs and the benefit of products induce the strategy 'premium product' and 'cost leadership'.

In the following, attempts are made to link these strategies to the knowledge structure of each knowledge type. Corporate strategies, as a result of a combination of the named strategies, combine the generated structures. Considering for example the 'outpacing strategy' (product with respectable properties for the customer, offered for as low a price as possible), it is necessary to combine knowledge structures referring to premium products and low cost products (cost leadership). Existing knowledge items in both structures will be transferred equally, knowledge items existing in singular in one of the two structures will be conducted to the new structure. Figure 6 gives a graphical example for combining knowledge structures.

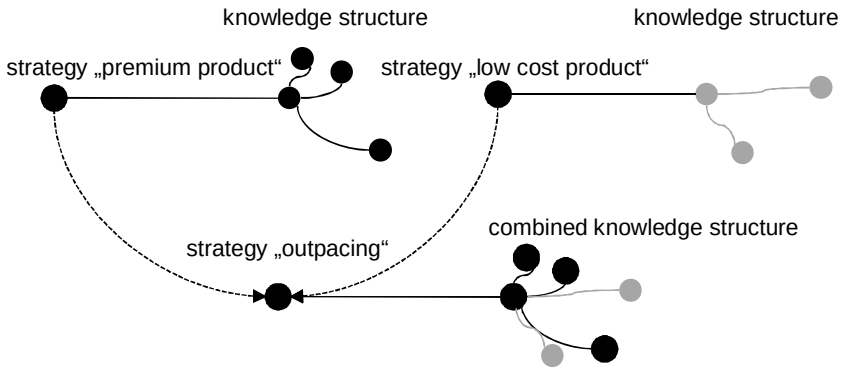

Figure 6. Combination of knowledge structures

3.3.2 Deriving target knowledge structuring models (TKSM)

Based on the elaborated knowledge structures, the TKSM should be developed in this section. Therefore, it is necessary to group related knowledge items within each knowledge structure. Afterwards, these groups must be brought together depending on their corporate strategy. This procedure will now be explained. Each corporate strategy can be defined by its specific parameters due to the characteristics. These parameters influence the knowledge structure. For this purpose, Table 4 offers the requirements (in extracts) on each knowledge structure with respect to the corporate strategy. Before presenting a result of application of these requirements on the specific knowledge types, some exceptions must be noted.

Table 4. Requirements on the knowledge structures with respect to the corporate strategy

Type of strategy	Overall characteristics
First to market strategy	Entry in unknown, usually not prepared market
• pronounced specialised knowledge for using new working principles, design principles or application principles	
• expertise in product know-how	
• detailed knowledge of customer wishes and requirements for scientifically based appraisal of the product functions needing to be fulfilled	
Late to market strategy	Establishing in existing markets – challenging the customer acquisition
• precise knowledge of the current market conditions and possible developments of market criteria, e.g. volume of sales	
• technological expertise as working principles and manufacturing processes must be understood	
• well-founded knowledge of distribution	
Low cost product strategy	Extreme cost-conscious development, minimum necessary customer benefit
• high level of methodical competence in value management (target-cost analysis, value stream analysis, function analysis)	
• specific expertise of customer needs according to their importance and meaning from the customer's perspective	
• comprehensive knowledge of manufacturing techniques and alternative production processes, not applied by the competitors in this context	
Premium product strategy	Highest customer requirements (quality, functions, etc.)
• knowledge of technical capabilities to perform explicit and implicit customer requirements regarding product functionality	
• detailed knowledge of the customer, wishes and needs	
• well-founded methodical knowledge ensuring the product quality, reliability requirements and failure analysis as well as the prevention of mistakes	

Knowledge of the product represents the key knowledge. Employees in the PDP must be able to dispose of it freely. Thus product knowledge appears to be universal and independent of strategic orientations. It is not possible to derive a TKSM for product knowledge.
Factual knowledge forms the technical and economical basis for a professional PD. Although there are several meanings for this knowledge type with regard to the different strategies, it is not possible to develop an efficient and cost-covering product without being aware of the facts in certain areas.
As an interim conclusion, it can be noted that the knowledge structures for specialised knowledge, market/customer knowledge and methodical knowledge can be reduced to the identified strategies. Again, there are some exceptions. The required specialised knowledge cannot be reduced considering the first to market strategy. The criterion for this strategy is to enter the market first. Under these prerequisites, normally no expertise exists in the area of designing and production as well as the deployed materials or designing principles. Specialised knowledge must consist of the entire structuring model without reduction. Methodical knowledge is particularly very extensive for the development of low-cost products. In this context, it is independent of the strategic background, the form or the function, which are absolutely essential. With regard to other arguments that are not mentioned in this paper, the reduction of the structure model of methodical knowledge is equally not possible.
Concluding Section 3, the reduced knowledge structure for the specialised knowledge is represented. A result for all reduced knowledge structures will be given in the section "discussion of the results".

3.3.3 Target knowledge structure model for specialised knowledge – showing the potential due to correlating corporate strategies

In order to illustrate the strategic oriented characteristics of knowledge structures, an excerpt of the knowledge structuring model (cf. to this the structure shown in Figure 3) for specialised knowledge is represented in Figure 7. As stated previously, reduction of the knowledge items is not possible by the strategic alignment 'first to market'. Due to a compact view in this figure, the strategic orientation of each knowledge type is represented by the abbreviations 'PP', 'LM' and 'LC'. This means for instance that the expertise in material sciences is only necessary within the premium product and low cost product strategy. However, the expertise of machine elements is required independent of the strategy (relevant for all strategies).

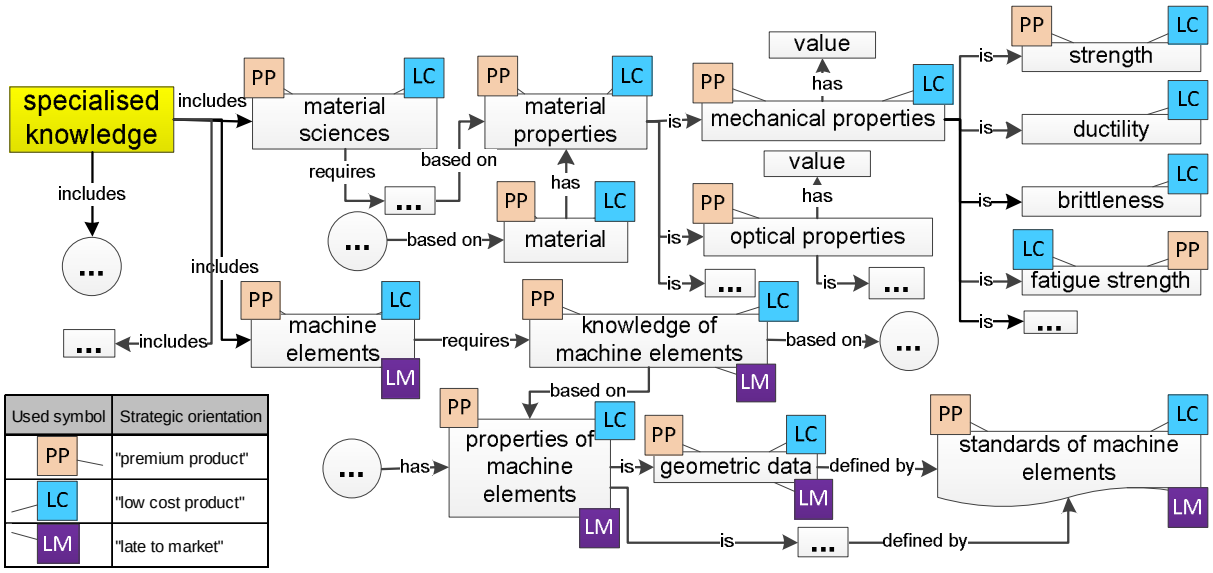

Figure 7. TKSM for specialised knowledge with regard to the corporate strategies

Focusing on the research question 3, it can be stated that reducing the knowledge structure of knowledge types with a weak contextual relationship is possible. Some influencing factors, such as for example the corporate strategy, have been identified, but there is still some scientific work necessary.

Application of the influencing factor “corporate strategy” has depicted, that it is basically possible to use factors to adapt the GSM to a specific structuring model of knowledge.

4. Discussion of the results

Beginning with the findings gathered mainly in Section 3, all postulated sub-research questions have been answered in a satisfactory way. As a result of this contribution, a procedure for extracting an adequate target knowledge base exists, following several steps. With respect to the type of problem, knowledge types have been identified with respect to their capability of being represented in semantic networks, as it is essential within the evaluation of product development knowledge. Critically, it must be added that it is absolutely necessary to prove the statements, particularly those concerning the influencing factors as well as the accuracy of the derived target knowledge structure model (TKSM) within empirical studies. The objective in this contribution was to offer general procedures highlighted with “practical" examples. The completeness of all parameters cannot be assured.
Finally, presenting (as mentioned in Section 3) the overall results for a discreet allocation of the corporate strategy to all identified knowledge types with a weak contextual relationship, proves that the formerly developed procedure achieves the goal to derive a more specific knowledge base. An excerpt analysing the specialised knowledge with respect to the corporate strategy has been given in Figure 7. Removing those knowledge items not fitting to purpose in the semantic network with respect to the corporate strategy induces a more specific semantic network. Therefore, analysing the nodes and links in each semantic network allows quantitative statements to be made (graphically processed in Figure 8). The highest reduction value has been carried out for market/customer knowledge as well as with the strategy ‘late to market’. According to the aforementioned exceptions, a reduction in product knowledge and factual knowledge is not possible. The average reduction value over all 20 relative reductions is 16.4 %. This value represents satisfying results regarding the level of detail and the depth of the edited semantic network.

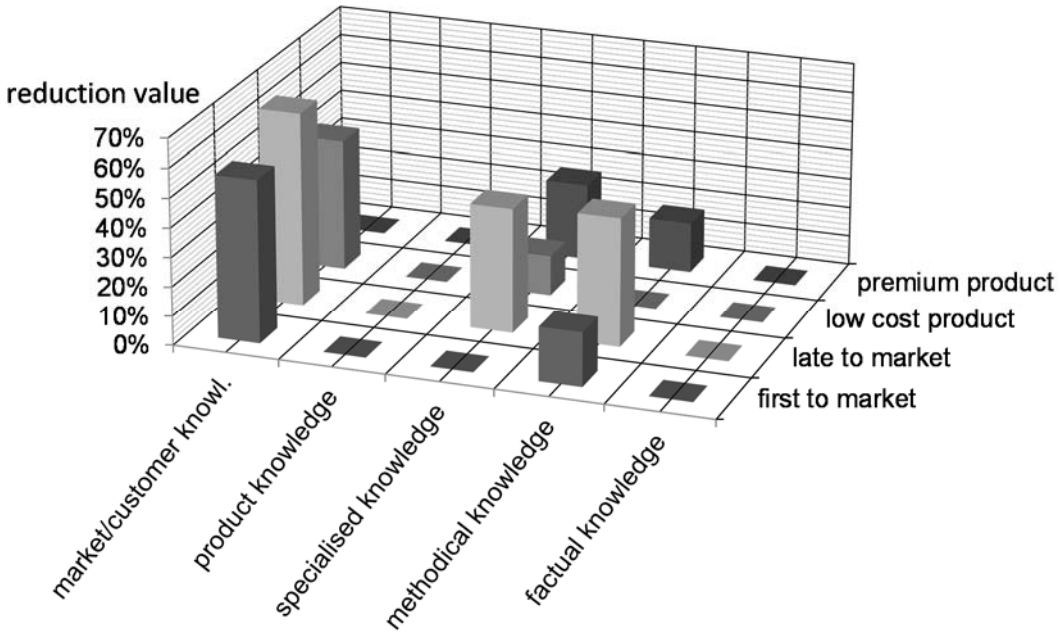

Figure 8. Percentage reduction in knowledge structures

5. Conclusion and outlook

The approach given offers new possibilities while evaluating knowledge within the product development process. Regarding the overall method itself, the main section is addressed to questions concerning the development of a target knowledge base for companies in the area of PD. Knowledge

can be target-oriented managed if the gap between actual knowledge in companies and the required knowledge (target knowledge) can be exposed.
Keeping in mind that the whole product development process can be described by knowledge types and that each knowledge type represents a huge variety of sub-knowledge, employees in companies need support to face this challenge. Following the proposals in this contribution leads to a procedure that reduces the aforementioned knowledge types with respect to the corresponding constraints. Yet, at present, the reduction is only possible in detail for the corporate strategies. This has to be expanded due to the branch, internal processes, etc.
Despite the use of discreet allocation leads to a significant reduction in the knowledge structure extents, the approach to reduce the knowledge structures must follow for the quasi-continuous approach.
The target-oriented structure reduces the complexity of the knowledge structuring model and thereby offers a more user-related and thus a more user-friendly development of the method within the overall project.

References

Binz, H., Keller, A., Kratzer, M., Messerle, M., Roth, D.: "Increasing Effectiveness and Efficiency of Product Development – A Challenge for Design Methodologies and Knowledge Management", The Future of Design Methodolgy, Birkhofer H. (Ed.), Springer-Verlag London, UK, 2011, pp. 79-90.

Chen, Z.: "On continuous AI and meta-knowledge", Journal of kybernetes, Vol. 22, No. 4, 1993, pp. 78-84.

Kakabadse, N., Kakabadse, A., Kouzmin, A.: "Reviewing the knowledge management literature: towards an ontology", Journal of knowledge management, Vol. 7, No. 4, 2003, pp. 75-91.

Lindemann, U.: "Konzeptentwicklung und Gestaltung technischer Produkte" [„engl.: Concept development and designing of technological products"], Springer-Verlag, Berlin, 2008.

Pahl B., Beitz W.: „Engineering Design – A systematic approach", Springer-Verlag London, UK, 2003.

Probst, G., Raub, S., Romhardt, K.: "Wissen managen – Wie unternehmen ihre wertvollste Ressource optimal nutzen" [engl.: „Manage knowledge – optimal use of knowledge by companies"], Gabler Fachverlage GmbH Wiesbaden, 2006.

Roth, D., Binz, H., Watty, R.: „Generic structure of knowledge within the product development process", Proceedings of the 11th International Design Conference – DESIGN 2010, D. Marjanovic (Ed.), FMNEA, Zagreb, 2010, pp. 1681-1690.

Schuh, D., Kromoser, R, Strohmer, M., Pérez, R., Triplat, A.: „The purchasing chessboard", Springer-Verlag, Berlin, 2009.

Suyeon, K., Euiho, S., Hyunseok, H.: "Building the knowledge map: an industrial case study", Journal of knowledge management, Vol. 7, No. 2, 2003, pp. 33-45.

Zboralski, K.: "Wissensmanagement durch Communities of Practice: Eine empirische Analyse von Wissensnetzwerken" [engl.: "Wissensmanagement by communities of practice: empirical analysis of knowledge networks"], Gabler Fachverlage GmbH Wiesbaden, 2007.

Dipl.-Ing. Daniel Roth
Acadamic assistant
University of Stuttgart, Institute for Engineering Design and Industrial Design (IKTD)
Pfaffenwaldring 9, 70569 Stuttgart, Germany
Telephone: +49 (0)711 685 60240
Telefax: +49 (0)711 685 66219
Email: daniel.roth@iktd.uni-stuttgart.de
URL: http://www.iktd.uni-stuttgart.de/forschung/mpe/PDKbench