Knowledge Demand Specification for KMS Decision Support

Ulrike Borchardt

University of Rostock, Chair of Business Information Systems
ulrike.borchardt@uni-rostock.de

Abstract. For implementing a suiting KMS (Knowledge Management System) solution for SME, the demands with regard to knowledge and the specific systemic support should be clarified. Since information in general is the starting point for defining knowledge, the question arises how knowledge and information demand are interrelated. In addition: can this be used for the determination of the according knowledge demand. This paper presents our findings on the usage of the knowledge demand gained within the creation of a framework for value-oriented decision support for KMS for SME.

Keywords: Knowledge Demand, Knowledge Management System, Information Demand, Observation

1 Motivation

Knowledge and information management as such are disciplines accepted within the research community. This includes the acceptance of the fact, that the fields are interlinked and dependent on one another. This is usually reflected using definitions of knowledge being based on information, however needing more context or linkage than information [7], [3]. Taking these assumptions to the level of demand analysis, the question arises whether "building knowledge upon information" holds as well for the knowledge demand analysis. The knowledge demand is supposed to deliver the basis for a decision on contents and systems to be applied within the range of knowledge management in organizations. This work is to present the prerequisites in terms of a knowledge demand for recommending a KMS in a problem and value oriented manner enhancing the framework described in our former work [15], [16]. The focus of this paper for this reason is not to generate a generally valid model on the differences between the information and knowledge demand, but to support the determination of knowledge services [6] which are to support knowledge work within the organization utilizing the knowledge demand. The emphasis consequently lies on the clear distinction between the terms of information and knowledge, instead of focusing the demand towards a new system as such. Nevertheless literature does not provide approaches for the knowledge demand as equally and methodical as they exist for the information demand, e.g. [5].

As for the issue whether to speak of demand or need for knowledge, we solve this problem for our work by considering knowledge demand and need equal terms describing the same goal and remain with the term of demand, since no final clarification can be found in literature. Since the knowledge demand has not been as equally explored as the information demand, yet the concepts of information and knowledge are depending on one another we chose the information demand as a starting point to provide us with answers on the following research questions:

1) How do the demands for knowledge and information differ?
2) How can observations be used in determining the knowledge demand for knowledge service recommendation?
3) How should the consequent demand be integrated within the framework for decision upon KMS Support?

The results and the methodology to gain answers to these questions are described in the following. Section 2 presents the starting point of our work, the information demand and the framework for KMS recommendation. Section 3 describes the conducted observations and their results. Following section 4 shows the integration of the knowledge demand into our framework and finally section 5 presents the conclusions of this paper.

2 Fundamentals

2.1 Information Demand

The general definition on the term of information demand provided by Picot [11] denotes that information demand describes the kind, amount and quality of information persons need for the fulfillment of their tasks within a certain period of time. Moreover, entering the field of information demand from the perspective of information logistics Lundqvist, [5] says that information demand is the constantly changing demand for relevant, up to date, reliable and integrated information, that supports (business) activities, whenever and wherever information is needed.
Putting this into practice results into the method of information demand analysis (IDA) [5] which takes the perspective of focusing on the roles with their tasks and responsibilities. The method itself consists of modeling activities, which strongly depend upon a participatory modeling, involving the individuals being modeled in their roles. This modeling approach uses a number of reference questions to be answered within the process to be able to extract the context of the information demand holding characteristics like: task, responsibility, role, information object and resources necessary.

2.2 A Framework for value-oriented recommendation of KMS for SME

Having by our own research [15] identified a problem arising for SME, namely the missing value-orientation in KMS support, the next step was to address this problem. Here the initial design of a framework addressing the problem of a missing value-orientation and guideline for KMS recommendation for SME is shown. The

framework was build using existing approached known from literature and combining them as e.g. suggested by Design Science research \cite{hevner}, when demanding a thorough use of the existing knowledge base.
The theoretical foundation for this work focusing on value orientation beside the monetary representation is presented by the use of the KMS Success model [4]. Since the concrete operationalization of the model is left open by the authors of the model, missing standardized adoptions lack support the exchange and comparison of precise experiences between individual enterprises as it might be of interest for SME. Nevertheless, the mere operationalization of the KMS success model as described in [4] is not sufficient for the use in SME, since it only shows what can be done after the choice for an implementation. This choice asks for methodological support as well, since even Maier [6] admits, that his architecture is an idealistic holistic construct and therefore demands adaptation. Yet his architecture offers the concept of knowledge services to be implemented for the systemic KM support. Considering these two components as the theoretical settled foundation of the technical perspective, a combination of these into service oriented technical support focused around the value to be offered was the initial starting point of our framework, as shown in Fig. 1.

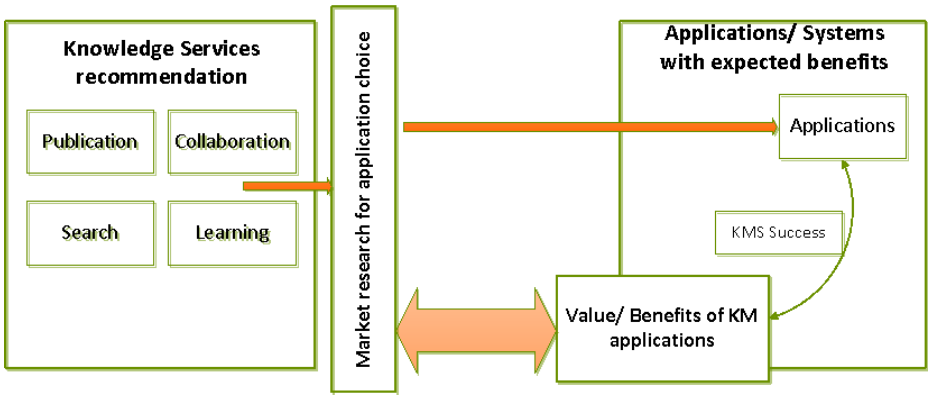

Fig. 1: The initial Framework for value-oriented decision support on KMS for SME

Consequently the recommendation is given on the knowledge service to be implemented by the SME, being implemented towards the value dimensions of the KMS Success model. Referring to models known from the field of CSCW (Computer Supported Cooperated Work), as e.g. the 3C model for groupware classification [14] and considering the validity of the framework as a possible reference we decided on a recommendation of application classes instead of concrete applications. This leaves the individual market research to the SME, yet allows also for further adaptation due to e.g. resources available within the SME. The recommendation on one knowledge service is also not supposed to neglect the other ones but provides the SME with an idea on what to focus first since it has the strongest demand. However, the idea of combining these theoretical components seemed reasonable from what they have to offer. To prove the value of the designed framework an evaluation as it is done for artifacts from Design science [10] is necessary. Doing this with the help of case studies it was revealed [17], that the framework in this state starts too late by directly

addressing the knowledge services to be supplied, and more context for the recommendation, the knowledge demand is needed.

3 Approaching the knowledge demand

3.1 Knowledge demand in the context of our work

Fig. 2 illustrates our general train of thought on approaching the knowledge demand, starting from the point of information demand. In the figure the starting point of the information demand is located on the lower left side. This demand is influenced by knowledge objectives as introduced by [9] as the starting point of his model "building blocks of knowledge management". The information to be delivered is influenced, since the objectives determine the orientation to which knowledge is to be developed and the according information has to be provided. Moreover, these goals are supposed to lead to actions and therewith have an action reference. Even the action reference itself determines a certain information demand, due to the context it creates which has to be reflected within the processes invoking information demand.

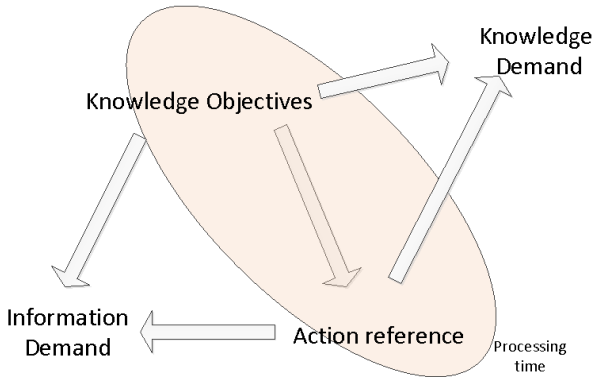

Fig. 2: Relation of information and knowledge demand

Hence when does the knowledge demand arise? The most significant issue for its occurrence from our point of view is the processing time, the time when the actual process or action takes place. During process time information is processed and demands certain actions and decisions to be performed. These however depend on the knowledge of the processor and consequently can invoke a knowledge demand, which certainly differs from the mere information demand of for fulfilling a task within the process.
When looking at the details of the information demand and the accompanying information demand analysis, the focus on the organizational perspective with its tasks, roles and processes can be seen for which the fulfillment should be guaranteed. Yet knowledge demand is more general focusing on the person in its current state of knowing, whereas the information demand reflects the demand mostly depending on

the role the person fulfills [5]. The knowledge demands in contrast focuses on that person, especially when aiming for a KMS support which is to be perceived as valuable by that user of a potential system. The aforementioned characteristics of the information demand will therefore not suffice, since they do not hold information on the individual, its skill set and the recent point in time, where the knowledge is to be applied. Consequently, for our purpose an extension of the concept is necessary to capture the knowledge demand.

3.2 Observing the knowledge demand

Considering the knowledge demand not being derived from the information demand, we had to consider how it can be approached, which lead to the question whether it can be observed. To address this we used the social empirical method of observations [13]. The object of the observations were knowledge intensive processes (KIP) to gather information on the knowledge searched for and used within such processes. Within this part of our research we focus on determining the components of knowledge in use as suggested by the acting competency model by [1].

Planning the observations we decided on conducting an open, non-participating, semi-structured observation. To retrieve useful results the observation should be conducted accompanied by an observation system holding signs, scales and/or categories [13]. Practically categories or mixtures are most common, yet all mark the setting of predefined events to be expected under observation. These have to be settled ahead of the observations either rationally by determining assumptions to be proved or empirically from conducting free observations. Though two preliminary observations were conducted we decided to go with the rational approach starting with assumptions to be proved. The decision was necessary due to the manifold details of knowledge work, which made it difficult to retain comparable data in a free observation. In general, an observation is always expected to be subjective, meaning that the interesting events are only an extract of the whole process taking place and the according documentations focus on the extracts only. Furthermore, we decided against a laboratory setting for the observation for once, since this would demand standardized KIP which is a contradiction in itself, KIP being described as highly non standardized, individual processes [12]. Moreover this would shift the focus to the knowledge needed in this single process, yet for us to see the general observability a more general focus was desirable.

Observation categories. To fulfill the approach using rationally identified observation categories [13], we made several assumptions to be proved with our work, which provided us with restriction criteria under observation.

1. KIP can hardly be worked through at once due to their length and their individual structures, as well as the structures of the working environment. The resulting criteria in use are: number of interruptions, length of the observation.
2. Knowledge demand is dependent on the skill set of the actor. Assuming that once acquired knowledge can be reused it has not to be demanded

repeatedly. Consequently, experience level and education of the observed are influencing the knowledge demand.

3. The operative knowledge demand occurs less often than the operative information demand. As mentioned before knowledge is internalized [8] whereas information changes frequently so updates occur more often. To reflect this we chose the category of used information and knowledge objects with their number of occurrences. This category also serves as an indicator for our next assumption.
4. Knowledge work relies on processing information into knowledge, however not all information is processed into knowledge.
5. Knowledge work depends on social interaction, determining the sources to fulfill the knowledge demand. This can be split into two parts: the demand for knowledge from other persons and the work of other persons within the process to fulfill a task. This assumption aims at the sources used to satisfy the knowledge demand. We therefore observed the applications in use by application classes (Mail clients, ERP systems, databases, text processing applications etc.) as well as whether the observed asked others for help (written or orally) and used internal or external knowledge objects.
6. KIP include regular application of different acting competencies resulting in demands for social competencies, personal competencies, method competencies, professional skills; as such the professional level determines the knowledge demand. Competencies can be considered internalized knowledge the worker is willing to apply for solving the task ahead [1] and consequently indicate the knowledge in use. The differentiation in the competencies is derived from the acting competency model by [1], where the competencies in combination build up the so called acting competency, allowing to perform the process task.

These assumptions show our way of determining the observation criteria to be able to restrict the different observations.

Results of the Conducted Observation. Though observation series are supposed to cover numerous processes we conducted only an overall of 12 due to the length of the observation and the availability of the observable processes. The following table **Table 1** provides an overview of these with a short description and the experience level of their processors.

Table 1. Observed Processes.

No.	Process Description	Length (min)	Processor Qualification
1	Programming deadline assignments	100	Apprentice (1st year)
2	Customer process: planning programming and requirements specification	105	CEO, University Diploma

3	Programming statistics public assistance benefits	60	Senior Software Developer
4	Questionnaire development on user behavior	40	Master Student "Business Information Systems"
5	Process optimization exam organization	90	Diploma "Business Administration", 5 years experience, 1 year on the job
6	Bash Script development for automated log analysis	90	Master "Information Technology" 0.5 years on the job
7	Self-Observation – preparation of seminar paper	120	Master Student "Business Information Systems"
8	Self-Observation – Generating Project documentation	60	Master Student "Business Information Systems", 1 year on the job
9	IT Administration for science institution	120	Master Student "Business Information Systems", 2 years on the job
10	Mirroring databases (new scheme)	60	Master "Information Technology" 0.5 years on the job
11	Allocating financial resources (university)	120	Master "Business Administration", 1 year on the job
12	Exam Organization	120	24 years in the job with according diploma

In general it can be seen that the observations took different amounts of time varying from 40 to 120 minutes, showing already first indications on the length of the KIP observed. In general always two persons observed one KIP with the help of the criteria described above. Consequently the results were compared and triangulated for the individual processes.

Interruption frequency: Overall we recorded 21 interruptions within the processes and in addition one process that needed several days for accomplishment though not being interrupted during observation. The interruptions can be classified into two categories: occurrences in the working environment and process related interruptions. The working environment settles for coffee breaks, meetings and colleagues entering with questions or problems. Two thirds of the observed interruptions were related to that kind. The process related interruptions included waiting for legwork, asking colleagues for help or opinions or waiting for the right information to be entered into the working system. Eventually (once) the process was interrupted due to the fact, that another KIP could be continued, which had a higher priority. However, we also observed processes to be finished, nevertheless we assume our assumption right that a straight workthrough is hardly to be accomplished.

Operative demands: With regard to the amounts of information and knowledge objects we observed the use of 25 knowledge objects and 38 information objects. The mere amounts of the objects therewith confirm our assumption. In addition we found more processes using a high number of information objects whereas the number of knowledge objects used usually is low. Yet the identification of knowledge objects

had to be done by the observer and eventually lead to asking for more details than could be observed.

Processing knowledge from information: the objects do not directly reflect how much of the information is processed into knowledge. This cannot be estimated from the outside. Furthermore, it is hardly possible to see already internalized knowledge applied to the tasks. The assumption can therefore not be supported.

Sources to satisfy knowledge demand: For the technical support: the observation showed the use of various application programs to be used for the accomplishment of the processes. 10 times word processing applications were used, 6 times email clients, also 6 observed the use of messenger systems, whereas in 7 cases a database was used and only 4 cases indicated intranet resource use. Moreover, several general editors, development environments and browser were used during observation time.

With regard to the use of knowledge elements in form of knowledge requested from colleagues or found in documents 93 occurrences were observed. 24 times the observed asked a colleague for help (16 oral, 8 written requests) the remaining 69 times knowledge elements were searched electronically. One third of the elements were located internally (21) whereas the other (48) where retrieved from the Internet. Anyhow, this observation missed the verification whether knowledge or information elements were used. Yet it shows that a partial demand is satisfied through social contacts. How often the process was depending on the input from other persons remained remains unclear due to the short time of the observation and the working interruptions though in processes 6,10,11,12 such interdependencies were found. In process 5 even the wish for someone to interact with was uttered. This assumption provided us with a concrete idea on what to integrate to satisfy knowledge demands nonetheless, which provides real linkage point for a KMS.

Different competencies in action: the overall amount of competency applications observed was 133. Of those 52 were professional skills, personal competencies were 6, social competencies 17 and 58 occurrences were method competencies. Accordingly the professional skills and method competencies sum up to over 80 %. These have to be supported as contents in the knowledge services, whereas the other request for special addressing by e.g. a KMS support.

Summary. Considering the suitability of observations for the determination of the knowledge demand we found that they provide us with a good impression of what is currently used to satisfy the knowledge demands. General habits on IS use can be recorded as well as the communication channels, which is of special interest for the integration in our framework.

Going back to our assumptions we see a tendency of confirmation for number 1, partly for number 4 and 6. For assumptions 2, 3 and 5 we cannot neglect the assumption due to the observation results. The whole observation lacks differentiation between information and knowledge since this can hardly be estimated by the observer, but must be requested from the processor. Accordingly, the observation type should be accompanied by the thinking aloud method. This partially was done by asking the processors on what they wanted to accomplish by using certain objects. In summary we could see that the knowledge demand differs from the information demand but are not able to name every difference in detail. Having a further look at

the methodology, several shortcomings could be found. The observation series cannot claim to be complete, due to its low overall observation objects.
Considering the above mentioned definition of information demand the question arises whether the knowledge demand behaves in a similar way. Lundqvist [5] e.g. says that information demand is constantly changing, however does the knowledge demand do as well? From the first observations made, it already became clear, that knowledge in the process primarily is the knowledge needed to find and process the information necessary to fulfill the process. Accordingly the knowledge demand from that regard changes with the process and the required skills. Consequently, the frequency of demanding new knowledge is lower than the one asking for new information. This however could not be proven completely with this observation series. It would demand an observation on the same process with various as well as the same processors for several times, which can hardly be done in a free setting as was chosen here but demands a laboratory setting.

4 Integrating the demand in the framework

With this section we provide our answer on the third research questions, showing the integration into our existing work. The work presented in this paper is part of our research on the evaluation of KMS systems with the help of the IS Success model [2] or its adaption in the KMS Success according to Jennex/Olfman [4]. The overall goal of that research is the establishment of a methodological approach to the decision making upon value-oriented KMS for SME. Anyway to be able to provide such approach, these models for the evaluation of the success of IS/KMS Systems needed adoption and further extension within their categories.
As a basis of our work, introduced in section 2.2 we extended the outlined framework from [15], [16] with the component of the knowledge demand to be able to provide a problem as well as value oriented recommendation and methodology to gain a decision on which KMS or KM application to use. Based on the knowledge demands as determined here we want to recommend suiting KMS services. The indications from the knowledge demand side certainly allow for some recommendation, when taken as a gap analysis. What is critical is the differentiation to be done between knowledge and information, which partly can be achieved within an observation but needs more interaction with the persons e.g. an interview or a questionnaire.

Assuming the knowledge demand as an essential for the decision on the KMS support, our current approach focuses on the individual knowledge demand to be observed since this focuses on the information systems in use and the shortcoming in the process of gathering knowledge, which can be retrieved by an observation of the usage of IS systems. An organizational knowledge demand determined from the processes and the tasks to be fulfilled certainly allows for conclusions on the contents to be provided for the fulfillment of the process. Our research work bases its recommendation of KMS on application classes for knowledge services as introduced by [6]. The use of these knowledge services within the architecture of a KMS has to be accomplished by the individuals; accordingly their needs define the knowledge demand in question. These partially can be determined with the help of observations

as shown here, since the use of technical and social support could be shown in the observations. Yet the organizational setting of the knowledge demand should not be forgotten, since the organization determines the working context of strategy, tasks and processes to be accomplished. Consequently, the integration in our framework can be depicted as shown in
Fig. **3**.

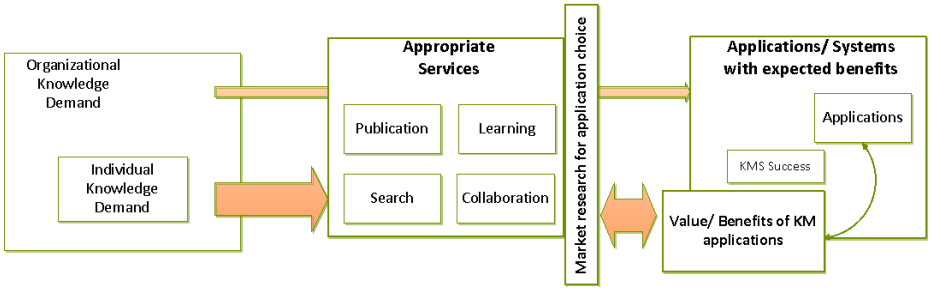

Fig. 3 The extended framework for value-oriented decision support for KMS in SME

As for the determination of the knowledge demand which is essential for the operationalization of the framework into a method, we can state with the work presented here, that this on the individual level can be done by a mixture of questioning and observing the individual employees. A mere observation should not be sufficient; since many aspects of the individual work are to be questioned by the observer, since the thinking and learning processes of the individual are not self-explaining. Nevertheless it should be kept in mind, that observations are very time consuming and with regard to standardization a questionnaire, for instance on the application use can provide equal results in shorter times. Furthermore a matching from criteria to be observed to knowledge services is needed, as illustrated in table Table 2. Taking for example the lookup frequency externally it can be stated that this motivates building up an internal knowledge base. The competency type observed however allows for recommendation on the support of collaboration (in case of high social competency requests), as does the frequency of contacts to others, may it be coworkers or customers. Interesting in this part was also the remark on the wish for someone to talk to about the work within the observations. This wish indicates a strong wish for more collaboration. These comments certainly should be taken into consideration in the decision making on the knowledge services to be supported.

Table 2. Observation criteria to services.

Knowledge service	Observation criteria
Publication	search for external documents, keeping own knowledge documents, contents requested, high amount of local storage
Search	long search times, missing links between documents, questions to colleagues on where to find things
Collaboration	communication with colleagues, use of shared documents, collaboration applications with colleagues and customers
Communication	communication with colleagues and customers, use of

	communication applications
Learning	use of e-learning, skill development within the processes, frequency of processes (e-learning as refresher)

Regarding our research work another refinement in the interpretation of knowledge demand could be made. By focusing on the technical support by KMS for the employees, the knowledge demand we are asking for is primarily the demand on knowledge services. Consequently we are able for now to neglect the concrete determination of a knowledge demand but are focusing on the demand for knowledge services on the individual layer and the organizational knowledge demand described within the processes and knowledge management strategy for the decision support we want to establish with our framework.

5 Conclusion and further Work

Beginning with reflection of the information demand versus the knowledge demand we were able to show our argumentation on the differences between the two. The argumentation alone however cannot hold for all fields concerned with knowledge and information demand, yet provides a point to start for the integration in our research work on value-oriented KMS for SME, especially showing the focus of the knowledge demand on the individual as such, whereas the information demand centers around individuals as roles.

We furthermore were able to show how observations on the knowledge demands could be conducted, showing also the disadvantages of the method for the highly personalized field in general demanding for explanation by the observed. Nevertheless we were able to identify certain criteria of use for the determination of the knowledge demand within our framework. Considering these criteria useful for the recommendation on the knowledge service the question arises, when they are to be observed and how large the sample of observations needs to be. This is worth a thought due to the fact, that observations are a rather long lasting procedure and observing all processes within an enterprise will hardly be possible. As mentioned before it is easier to recheck them or gain an impression on the actual use of applications and habits gained from a questionnaire beforehand. Moreover for the knowledge demand to be considered for our recommendation a look at the personnel development from the viewpoint of skill development might be useful to be able to put forward the right contents, e.g. as a push system. This would also be based on the architecture of a centralized KMS as suggested by Maier [6], filling the personalization layer as well as the publication contents to be provided.

Combining these thoughts and the conducted observations an analysis set for the knowledge demand can be outlined consisting of several method supports:

- process analysis
- personnel development
- questionnaires
- observations

Using all of them should provide a profound impression on what is needed, but on the other hand causes a lot of effort. Consequently a selection would be recommendable.

Therefore another discussion could be helpful, always concentrating on the goal to provide suiting KM services, namely the effect of individual knowledge demand and organizational one. With regard to the contents to be provided both of them are needed, however for the mere knowledge service recommendation the individual one weighs more since it determines the channels used for the satisfaction of the demand. It shows the gaps in supporting systems and provides a stronger indication for the according knowledge services. The according conclusion for the observation conducted here, is that it provided some valuable insight in the knowledge demand and left us with the question on a general difference between information and knowledge demand, though indications could be collected. The actual integration of these two concepts into our framework was shown in section 2.2, clarifying, that the knowledge demand needed for such a recommendation can be narrowed down to a demand on knowledge service support.
With regard to further work to be conducted we are now facing the effort of transferring the framework into a method applicable for SME. Furthermore a validation of the framework in practical application is necessary to prove validity of the theoretically constructed artifact of our research work.

References

1. Brocke, J.; Buddendick, C.; Schneider, D.: Handlungskompetenz im E-Learning: Ein theoretischer Bezugsrahmen zur Kompetenzentwicklung von Lehrenden an Hochschulen. In: Neue Trends im E-Learning. Springer, (2007), S. 415-426
2. Delone, W.; McLean, R.: The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. In: J. Manage. Inf. Syst.19 (2003), April, S. 9-30
3. Fricke, M.: The knowledge pyramid: a critique of the DIKW hierarchy. In: Journal of Information Science 35 (2009), Nr. 2, S. 131- 142
4. Jennex, M.: Assessing Knowledge Management Success/Effectiveness Models. In: 37th Hawaii International Conference on System Sciences, HICSS35, IEEE Computer Society, (2004)
5. Lundqvist, M.: Information demand and use: improving information flow within small-scale business contexts, Linköping, Diss., (2007)
6. Maier, R.: Knowledge Management Systems: Information and Communication Technologies for Knowledge Management. Third Edition. Berlin Heidelberg, (2007)
7. North, K.: Wissensorientierte Unternehmensführung: Wertschöpfung durch Wissen. Gabler Verlag, (2010)
8. Nonaka, I.; Takeuchi, H.; Mader, F.: The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation. Oxford, USA : Oxford University Press, (1995)
9. Probst, G.; Romhardt, K.; Raub, S.: Managing knowledge: Building blocks for success. (1999)
10. Peffers, K.; Rothenberger, M.; Tuunanen, T.; Vaezi, R.: Design science research evaluation. In: Design Science Research in Information Systems. Advances in Theory and Practice. Springer, (2012) S. 398-410
11. Picot, A.; Reichwald, R.; Wigand, R..: Information, organization and management. Springer, (2008)
12. Roumois, U.: Studienbuch Wissensmanagement. In: Grundlagen der Wissensarbeit in Wirtschafts-, Non-Profit-und Public-Organisationen, Orell Füssli (2010)

13. Schnell, R.; Hill, P.; Esser, E.: Methoden der empirischen Sozialforschung. Oldenbourg Verlag, (2011)
14. Sauter, C.; Morger, O.; Mühlherr, T.; Hutchison, A.; Teufel, S.: CSCW for strategic management in Swiss enterprises: An empirical study. In: Proceedings of the Fourth European Conference on Computer-Supported Cooperative Work ECSCW95Springer, 1995, S. 117-132
15. Borchardt, U. (2011a). Towards Value-Driven Alignment of KMS for SME. In Business Information Systems Workshops (pp. 220-231). Springer Berlin Heidelberg.
16. Borchardt, U. (2011). Towards a Value-oriented KMS Recommendation for SME. In KMIS (pp. 347-350).
17. Borchardt, U.; Reck, J.; Lantow, B. (2014): Determining and Evaluating the Benefits of KM Tool support for SME. To be published in KMIS 2014