KMS re-contextualization – recognizing learnings from OMIS research

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Abstract

Purpose – Deployment of knowledge management systems (KMSs) suffers from low adoption in organizational reality that is attributed to a lack of perceivable added value for people in actual work situations. Poor task/technology fit in the process of knowledge retrieval appears to be a major factor influencing this issue. Existing research indicates a lack of re-contextualizing stored information provided by KMSs in a particular situation. Existing research in the area of organizational memory information systems (OMISs) has thoroughly examined and widely discussed the topic of re-contextualization. The purpose of this paper, thus, is to examine how KMS design can benefit from OMIS research on approaches for re-contextualization in knowledge retrieval.

Design/methodology/approach – This paper examines OMIS literature and inductively derives a categorization scheme for KMS according to their strategy of re-contextualizing knowledge. The authors have validated the scheme validated in a multiple case study that examines the differentiatory value of the scheme for approaches with various re-contextualization strategies.

Findings – The classification scheme allows a step-by-step selection of approaches for re-contextualization of information in KMS design and development derived from OMIS research. The case study has demonstrated the applicability of the developed scheme and shows that the differentiation criteria can be applied unambiguously.

Research limitations/implications – Because of the chosen case study approach for validation, the validation results may lack generalizability.

Practical implications – The scheme enables an informed selection of KMSs appropriate for a particular OMIS use case, as the scheme's attributes serve as design rationale for a certain architecture or constellation of components. Developers can not only select from various approaches when designing re-contextualizaton but also come up with rationales for each candidate because of structured representation. Hence, stakeholders can be supported in a more informed way and design KMSs more effectively along organizational change processes.

Originality/value – The paper addresses an identified need for systematic characterization of KMS approaches and systems intending to meet the objectives of OMISs. As such, it allows streamlining further research in this field, as approaches can be judged according to their originality and positioned relative to each other.

Keywords Classification, Knowledge management systems, Organizational memory information systems

Paper type Research paper

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1. Introduction

Knowledge management systems (KMS) have been recognized as essential socio-technical instruments to facilitate organizational learning since more than two decades (Damodaran and Olphert, 2000). KMSs are organizational information systems that focus on "capturing important (content and process) 'knowledge' and making it available to employees as required" (ibid.). Though their relevance and potential added-value is well-understood and argued for organizational development in literature (Gold *et al.*, 2001), their practical deployment has remained below expectations in terms of reach and impact (Lin and Huang, 2008). The lack of adoption appears to be influenced by several impact factors, most importantly among them the lack of perceivable added value for operative staff in actual work situations (Damodaran and Olphert, 2000; Lin and Huang, 2008).

Recent research still diagnoses the lack of perceivable added value for operative staff because of poor task/technology fit (Baloh, 2007; Turner *et al.*, 2009), which can be attributed to the lack of contextualizing the information provided by KMSs in a particular situation (Baloh *et al.*, 2012; Barros *et al.*, 2015). Knowledge needs of organizational actors in business-relevant situations seem to be largely ignored in terms of the selection of relevant content and appropriate delivery channels (ibid.). The present article aims at contributing to address this issue by providing a framework for considering re-contextualization options in KMS selection and design. Re-contextualization here refers to the process of delivering knowledge stored in a KMS to actors in a particular work situation in a way that enables them to adopt this knowledge to complete their task at hand (Schwartz *et al.*, 2000). We hypothesize that existing research in the area of organizational memory information systems (OMISs) can inform KMS design in this area, as the topic of re-contextualization has been thoroughly examined and widely discussed in this field.

OMISs have been introduced almost 30 years ago (Wegner, 1987; Barros *et al.*, 2015). Research has focused on the opportunities for organizational stakeholders to use existing information, therefore pursuing similar objectives as KMSs. Research under the OMIS label is usually linked to adopting a socio-technical perspective on knowledge use and sharing in actual work situations (Ackerman and Halverson, 2004; Ackerman *et al.*, 2013b), while KMSs research usually adopts a more techno-centric perspective on knowledge storage and retrieval (Toledo *et al.*, 2011; Zhang *et al.*, 2011) and often does not explicitly consider the social and organizational context of knowledge delivery.

Hence, OMISs research, in general, is complementary to research on KMSs with respect to knowledge delivery and, thus, could inform approaches to address the issue of re-contextualization in KMS design. *Consequently, the key objective of this work is to develop an understanding of how KMS design can benefit from OMIS research on stakeholder-centered and (procedurally) structured ways of re-contextualization in knowledge retrieval.*

OMIS research offers different perspectives on re-contextualization, which we consolidate in a common framework. The framework should highlight different options on re-contextualization, allowing to explicitly consider this aspect in KMSs selection and design. Methodologically, we have conducted a literature survey to identify existing approaches to re-contextualization in OMISs, including schemes to structure them. We further screened the literature for (possible) connectors allowing for a combination of existing structure schemes. After identifying and checking the relevance of each connector, we aggregated the findings in a comprehensive categorization framework. This framework allows the classification of approaches into categories by matching the properties of an approach with differentiators specified for each of the different categories. The validity of this framework has been checked by applying it to state-of-the-art KMISs approaches.

We have structured the paper as follows: Section 2 provides an introduction to the field of OMIS, outlining its contributions to the issue of re-contextualization. Section 3 develops dimensions that can be used for structuring and analyzing re-contextualization approaches from existing OMISs research. Based on these findings, in Section 4, we propose a framework for re-contextualization approaches. In Section 5, we report on our efforts on validating the framework by applying it to a variety of KMSs approaches. Section 6 discusses our findings and lists potential implications of our proposed research for theory and practice. Section 7 concludes the paper summarizing the objectives, our results, identified limitations of our approach and future studies.

2. Organizational memory information systems

In this section, we give a brief overview of the history of OMISs research and show that re-contextualization of knowledge captured by and stored in OMISs is a key property of these approaches and has been addressed from various perspectives over time. This diversity of re-contextualization approaches that stem from various scientific disciplines is a key asset of OMISs research that so far has not been recognized in its whole breadth in KMSs research. We hypothesize that a structured review of re-contextualization approaches in OMISs research will allow to inform KMS design processes and open new perspectives on knowledge retrieval in KMSs.

Observing human memory systems in terms of their functionalities and benefits and using these findings for establishing memory systems for organizations has constituted a research field that historically has involved several scientific disciplines and communities. The increase of technological capabilities and possibilities has induced organizational memory developments throughout several research disciplines, comprising social sciences (Kankanhalli *et al.*, 2011), information systems (Barros *et al.*, 2015), artificial intelligence (Horvitz *et al.*, 1998) and other related research directions. OMISs denote organizational memory systems based on technical systems. First approaches have been published in the 1980s (Wegner, 1987).

The 1990s and early 2000s have seen a rise in OMISs research. The AnswerGarden system can be considered an early prototypical implementation of OMISs (Ackerman and Malone, 1990). Further approaches were introduced by various research communities, in particular Computer Supported Cooperative Work (CSCW), for example, Ackerman *et al.* (2013a) and information science, mainly offering a variety of technologies for information storage (Horvitz *et al.*, 1998; Kuhlmann and Deiters, 2000; Budzik and Hammond, 1999). Other approaches like Abecker (1997), McDonald and Ackerman (2000) and Mentzas *et al.* (2001) tried to cover each aspect of an organizational memory, ranging from generating to using knowledge and, thus, can be considered comprehensive with respect to organizational stakeholder support. In the early 2000s, a reduction in the comprehensiveness of the proposed approaches was observed. Typical examples of these labels are process-oriented information delivery (Savvas and Bassiliades, 2009) and expertise sharing systems (Keary, 2004).

The problems and limiting factors of the OMISs concept have been studied from the beginning of its development intensively by members of the CSCW community. This research revealed that a major influence factor on the success of OMISs deployment in practice is the re-contextualization of already stored information (Bannon and Kuutti, 1996). Beyond that, Ackerman and Halverson argue in their re-examination of OMIS approaches that the issues of de- and re-contextualization of information are difficult to master, as they increase with the complexity of the problem that needs to be solved (Ackerman and Halverson, 1999).

Aside from the CSCW community, researchers from other fields have identified the problem of re-contextualizing knowledge as being crucial for KMSs. They address context awareness and, as such, the re-contextualization of information. Re-contextualization is crucial to support knowledge workers in their organizational environment, as Hipp *et al.* argue in their analysis of context-aware, personalized delivery of process information (Hipp *et al.*, 2011).

This overarching recognition of re-contextualization reveals that it is inherent to the idea of OMISs. Hence, KMSs research is likely to benefit from existing research on OMISs approaches in terms of overcoming the most urgent acceptance problem – re-contextualization.

3. Approaches on re-contextualization in organizational memory information systems research

The lack of a scheme supporting the classification of approaches on re-contextualization on OMISs could be attributed to the heterogeneous disciplines that have contributed to the development and consequently the vague positioning of OMISs and related systems. This has revived the interest in adopting comparative methodology and literature research, focusing on fundamental aspects including the concepts, information systems and management processes in organizational memory research, which we aim at contributing to with the present article.

Existing OMISs approaches addressing the issue of re-contextualization (Ackerman *et al.*, 2013a; Holz *et al.*, 2005) rarely systematically position themselves in a wider context but rather compare their work with directly related approaches. However, a more comprehensive, systematic approach could help identifying the overall state-of-the-art when looking for potential ways on re-contextualizing information. In the following, we develop the foundation of such a systematic approach by identifying different ways OMISs research has adopted to tackle re-contextualization.

3.1 Methodology

The aim of the categorization scheme is to systematically characterize approaches and systems intending to meet the objectives of OMIS. Consequently, we have chosen to review literature that has been published under the OMISs label and inductively identify commonalities and differentiators for the identified approaches.

The literature search was conducted for research on OMISs, covering both academic and practitioner sources. This was done via a literature review (Webster and Watson, 2002) using search engines and catalogues (Google Scholar, ISI Web of Science, IEEE Xplore, ACM Guide), publishers' platforms (ScienceDirect, EmeraldInsight, SpringerLink) and by retrieving secondary citations via forward and backward search strategies. The whole body of literature assembled in this way was examined regarding their approaches to re-contextualization of knowledge.

When reviewing the approaches to re-contextualization, similarities could be identified, which allowed to develop a multi-level categorization scheme iteratively. This categorization scheme is based on differences in how re-contextualization of information is approached during knowledge delivery and which sources of information are used to realize re-contextualization. The categories are described in the following.

3.2 Process-oriented re-contextualization

Process-oriented approaches focus on systems supporting the process of knowledge sharing among human actors. These approaches have been developed mainly in the field of CSCW and have been influenced by the collaboration-centric view on knowledge management (KM) prominently represented there. The CSCW community considers KM as a set of

communication processes in a social environment between human actors. Knowledge is something that is held by people, is part of a certain situation and, thus, cannot be separated from its social component (Ackerman *et al.*, 2013a; Abecker *et al.*, 1998). Re-contextualization, thus, is conceptualized as a social process that needs to be facilitated but cannot be carried out by means of IT alone.

Ackerman *et al.* (2013a) provide a review of how the CSCW community has approached the topic of KM in general and OMIS in particular. The following two subsections are derived from their main findings. With respect to re-contextualization, we could identify two process-oriented sub-categories that can be distinguished along the historical development of OMIS-centric CSCW research. Both of them adopt a process-oriented perspective on KM but differ in the way they propose to support re-contextualization of knowledge.

3.2.1 Knowledge sharing. The first generation of CSCW research in KM can be subsumed by the label 'knowledge sharing'. Tools developed under this label allow organizational members not only to externalize but also to share their informal knowledge. Technical support often focusses on communication functionalities for achieving these objectives. Externalization in that context means adding personal knowledge to a repository and, thus, becoming available to other organizational members. These approaches also recognize the influence of social factors when designing the functionalities of corresponding systems and focus on social aspects of knowledge sharing (Ackerman *et al.*, 2013a).

A crucial point for sharing knowledge is its de-contextualization from the social context when being added to the repository. However, the original context needs to be captured to enable re-contextualizing knowledge. Re-contextualization here is considered a social and situated process that is influenced by a variety of factors, including the expertise of the author, the reliability, authoritativeness, the quality and intelligibility of represented information, the nature (provisional or final) of information and possible mistrust because of obsolescence and incompleteness. Although these factors should be considered, they are hard to capture automatically and mostly need to be added to the repository manually. Consequently, the maintenance of data in the repository is a crucial task and, thus, requires substantial effort (Ackerman *et al.*, 2013a).

3.2.2 Sharing expertise. Approaches covered under this label represent the second generation of systems proposed by OMIS-centric CSCW research. The main goal of these approaches is to overcome deficiencies that resulted from first-generation approaches that resulted from the large effort required to maintain the knowledge repositories. Second-generation approached, thus, aim at supporting knowledge exchange directly between the involved individuals or collectives. To meet that objective, these CSCW systems combine tools discovering social relationships, topics of interest and expertise of organizational members (Ackerman *et al.*, 2013a).

Research on such approaches has been triggered and strongly influenced by the concepts of communities of practice (Wenger, 1999) and social capital (Ackerman *et al.*, 2013a). The first system explicitly aiming at targeting these issues, IBM's "SmallBlue", considers information about the social distance between each user and experts matching user data (Lin *et al.*, 2008). More recent approaches focus on social relationships and imply that expertise can be considered a parameter of the position or job profile of an organizational member (Guy *et al.*, 2008; Abecker *et al.*, 2000).

Expertise-sharing approaches hold responsible the social actors involved in knowledge exchange to address the issue of re-contextualization directly in their interaction. Still, match-making between information seeker and the knowledgeable expert can be supported by providing metadata about available knowledge and information demands. Such metadata indirectly supports re-contextualization via the involved actors.

3.3 Product-orientated re-contextualization

Product-oriented OMISs approaches consider knowledge as a tangible resource that is created within an organization and can be stored, reused and formalized. Product-oriented approaches aim to externalize knowledge from persons and map it onto structures that enable storage for further distribution. This understanding contrasts the process-oriented view that considers knowledge to be inseparable from the involved actors and the social context of its creation (Abecker *et al.*, 2000). While the process-oriented approaches intend to address the issue of re-contextualization by allotting it to the involved social actors, product-oriented approaches focus on providing technical support on re-contextualization.

Different types of product-oriented approaches with respect to how they address re-contextualization can be identified in literature. In general, product-oriented approaches capture some kind of context representation of each piece of knowledge stored in them and try to match it to the information seeker's context in the retrieval process. They differ in how they approach the problem of context identification and matching.

As described by Brown and Jones (2001), a system can take two options for identifying the information seeker's current context: either having it specified explicitly by the information seeker or determining it automatically from data available within the technical system. The latter approaches (Holz *et al.*, 2005; Abecker *et al.*, 2000) aim at delivering relevant data to information seekers without a specific query or system interaction. In the following, we conceptually delineated the OMIS-research focusing on context identification and matching for re-contextualization in knowledge retrieval in three categories.

3.3.1 Determining context through external sources. Knowledge retrieval systems unaware of an information seeker's current context requires external sources, usually the information seeker himself, to provide a proper context for relevant information. The term "external sources" in this category consequently refers to the fact that the system itself is not delivering context-sensitive information to an information-seeking user without active user involvement in context provision. Approaches on how to perform context provision varies. Some OMISs provide searchable case databases that display contextual information captured during the storage process and let information seekers perform the matching to their current context. Other approaches provide query engines for ontology-based retrieval requests. Among the most frequently used techniques for processing queries are ontology-driven reasoners and similarity-based case-based reasoning (Bergmann and Schaaf, 2003); the re-contextualize stored knowledge by supporting information seekers in formulating their knowledge needs in a structured way.

3.3.2 Context determined by systems. Systems that can determine context-sensitive information through other sources than the user do not require immediate user interaction for re-contextualization. These sources are often business process models, workflow engines or artefacts related to the users' current tasks (Holz *et al.*, 2005).

Reviewing existing approaches allows recognizing differences in the upfront modelling effort required for match-making between contextual information stored during capturing and the current context of the information seeker. We here distinguish heavy- and light-weight approaches. Heavy-weight approaches, such as KnowMore (Abecker *et al.*, 2000), require high upfront modelling effort to generate a reliable information basis, as all information necessary to determine the user context needs to be specified for tasks and business processes. Light-weight approaches, such as the Watson project (Budzik and Hammond, 1999), support weakly structured but still knowledge-intense tasks and require low upfront modelling effort.

3.3.2.1 Heavy-weight approaches. Heavy-weight approaches are characterized by high upfront modelling effort for modelling context-relevant knowledge from other sources than

users. Systems following this approach structure contextual information using semantically refined differentiators for re-contextualization during knowledge retrieval. Process models and workflow steps are often used as sources for this contextual information. Using them as a basis for re-contextualization mainly makes such approaches suitable for repetitive and highly structured tasks. High effort would be required to determine context descriptions for agile and weakly structured processes and workflows. As such processes are inherent to knowledge-intense work, KMSs require corresponding modelling functions (Holz *et al.*, 2005). Recent research on adaptive case management and case management modelling has shown potential for deploying novel, less structured but still semantically exact modelling methods in this context (Auer *et al.*, 2014).

3.3.2.2 Light-weight approaches. Light-weight approaches require lower upfront modelling effort to enable structured capturing of context information. Such approaches are suitable for re-contextualization based on weakly structured processes. The work with generic usually data- and pattern-based differentiators for the identification of relevant contextual information. For instance, the Watson system (Budzik and Hammond, 1999) analyses artefacts that a potential information seeking individual is currently working with and discriminates documents based on similarity to identify and deliver possibly relevant knowledge. As the selection criteria in light-weight approaches are generally more generic compared with heavy-weight approaches, they implicate a higher risk for delivering irrelevant information.

An evaluation of the Watson approach showed that when working solely with light-weight methods, the major identifying factor during re-contextualization is the similarity to information seekers' currently used artefacts. This strategy turned out to be able to successfully re-contextualize relevant knowledge stored in the OMISs. Empirical results, however, have shown that task-specific information was perceived to be less useful for information seekers. This deficiency might be overcome by using additional task-specific context descriptions for re-contextualization (Kleinberg, 1999).

3.4 Summary

Overall, available OMISs research shows fundamentally different approaches on re-contextualization of knowledge in the retrieval process that differ along two dimensions. The first dimension focusses on the subjects knowledge can be anchored on – we here can distinguish between approaches that consider knowledge inseparable from human actors ("process-oriented" approaches) and approaches that consider knowledge to be extractable by and representable in IT-based systems ("product-oriented" approaches). The second dimension is determined by how the context of an information seeker is determined. We could identify approaches that require strong user involvement and approaches that rely on information that can be automatically determined by an information system. Figure 1 provides an overview of these orthogonal dimensions and allows to situate the different classes of approaches on a two-dimensional plane.

The large amount of human involvement in modelling structures for context classification in heavy-weight approaches is reflected in positioning the respective class of systems on the y-axis in Figure 1. Also, "knowledge sharing" is positioned in the lower region of the upper left quadrant, reflecting the human effort required to collect contextual information during knowledge capturing.

In the next section, we use this structure as a foundation to develop a framework in the form of a decision tree to select appropriate re-contextualization approaches for usage scenarios determined by specific social and technical settings. This framework can be used

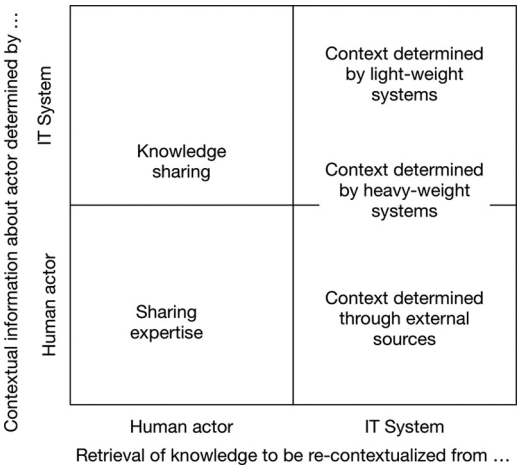

Figure 1.
Re-contextualization dimensions

in KMSs design and selection processes to match a system's approach on re-contextualization to the social, organizational and technical setting it should be deployed in.

4. A framework for knowledge management systems re-contextualization

The types of approaches identified in Chapter 3 and summarized in Figure 1 correspond to structural items that can be visualized in a multi-layered framework. Each layer is represented in Figure 2 by a rectangle containing two contrastive categories. Categories that can be split up into further sub-categories, which are visualized on the next layer. The distinction criteria for categories are anchored on the work situations to be supported on each layer. They are visualized left of each category. The differentiators are allocated in Figure 2 to layers and specified in Table I. The hypothesis of this work is that different approaches on re-contextualization proposed in OMISs research can be structured along their view on how knowledge can be delivered to an actor in a particular situation. Starting

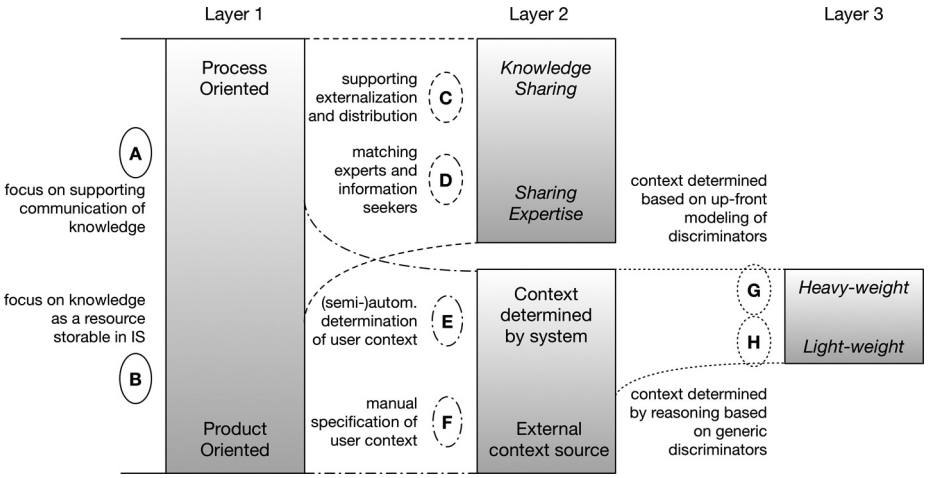

Figure 2.
Classification scheme

Criterion	Situational differentiator
A	The work situation requires supporting communication of knowledge between human actors. Knowledge is highly personal and inseparable of a specific situation and its human actors
B	The work situation requires to use knowledge as a resource by externalizing and storing information in information systems. Re-contextualization needs to be achieved without relying on social processes, using methods stemming from the field of information technology
C	The work situation can be appropriately supported by externalization and redistribution of information
D	The work situation requires that experts and information seekers are matched with support of an information system, as externalization likely leads to loss of crucial information. Re-contextualization of information is not provided by the system and requires communication between the concerned parties
E	The work situation allows to determine the user's context and deliver context-sensitive information without an explicit user-context identification or source of information. The problem of re-contextualization of information is tackled through acquiring information obtained by other sources than the user
F	The work situation does not allow to determine a user's context automatically and needs to rely solely on the manually specification of all relevant context information to deliver the respective information. Accordingly, re-contextualization is achieved by matching user defined-context with specific differentiators linked to the stored information
G	The work situation mainly features highly structured processes and allows extensive upfront modelling effort of context sources. Re-contextualization is achieved using differentiators that link stored information to specific context information
H	The work situation mainly consists of agile, weakly structured processes and only allows minimal upfront modelling effort. Re-contextualization is based on highly generic differentiators that link stored information to weakly defined context elements

Table I.
Framework for classification of re-contextualization approaches

from the very left, the scheme can be traversed by matching the differentiators until no further sub-categories are specified. This ultimately leads to one particular approach on re-contextualization that is considered suitable in OMISs research for the situation designated by the path taken through the framework.

The categorization framework adopts a multi-layered structure as shown in Figure 2 and contains the differentiators listed in Table I. Its application allows describing or reviewing KMSs approaches with respect to how context re-construction is approached conceptually. The classification criteria reflect how an approach could resolve context re-construction. The strategy for context re-construction evolves from the more generic (left) to the more concrete (right). It encodes the way how to apply the framework in development practice. The utmost left layer classifies approaches according to their intention of solving the problem of context re-construction by system means (product-oriented) or requiring worker communication (process-oriented). In the following layers, the strategy for context re-construction is further refined, either by relying on user interaction with or through the KMSs or by information retrieval features of the KMSs.

5. Application and validation

To validate the classification framework, we apply our classification scheme to different existing KMSs approaches and examine the adequacy of the specified criteria with respect of acting as differentiators for specific approaches. This allows drawing conclusions on to which extent the objective, to develop a classification scheme allowing to systematically characterize KMSs approaches and systems intending to meet the objectives of re-contextualization pursued in OMISs, could be reached. The next sub-section describes the

methodology adopted for validation. In Subsection 5.2, we describe how the cases have been selected from the body of available KMSs approaches. Subsection 5.3 reports on the results of the case study by briefly describing the selected approach and the classification result when applying the categorization scheme. We close with a summary of the experiences made when applying the categorization scheme.

5.1 Methodology

The classification scheme is validated methodologically using the multiple case study approach (Yin, 2009). The following paragraphs describe the research design for validation. They are structured along Yin's components of research design for case studies.

The following *research question* can be derived from the aforementioned objective as a starting point for the empirical design:

> *RQ1.* Does the classification scheme allow to unambiguously classify knowledge management systems approaches by assessing them in light of the specified classification criteria?

The case study this work reports on strives to provide answers to this question. The following *proposition* informs the empirical design: *The specified classification criteria can be used to unambiguously classify any KMS approach through traversing the layers of the classification scheme by making a binary decision on each layer based on the properties of the approach.*

The respective *units of analysis* for the case study are descriptions of KMSs approaches provided in literature as described above. To reach our objective, these approaches should be published no earlier than 2005, when the concept of OMISs has vanished from literature. The units of analysis call for a *holistic multiple-case study design*, in which each case is represented by a scientific article and is examined coherently using the same evaluation approach. Multiple cases are required to be able to assess criteria along the different classification paths provided in the framework. The *assessment of the research proposition* requires data that show how descriptions of KMSs approaches can be matched to the criteria specified in the classification scheme. The data have to be *interpreted* with respect to whether the criteria could be applied with or without ambiguity.

5.2 Case selection

In case study research, the selection of the cases is vital to generate sound and meaningful results. For the present study, the cases need to be selected from KMSs literature to validate the specified criteria. The categorization framework has five potential end-points with one – process-oriented knowledge sharing – hardly being adopted in more recent OMISs research. Consequently, the process-oriented differentiator is only tested in one case, whereas three cases have been selected to test the product-based differentiators. This approach still assesses all relevant paths through the framework.

5.2.1 Case 1 (process-based approaches). Existing literature reveals several approaches on sharing expertise and recommendation, for example, Balog and De Rijke (2007), Li *et al.* (2011), Lin *et al.* (2008), Guy *et al.* (2012), Karimzadehgan *et al.* (2009) and Balog *et al.* (2009). When selecting papers for further analysis, the ones published between 2008 and 2012, meeting the criterion of timeliness, and their assumable scientific relevance (measured by the impact factor of the publisher) were taken into account. According to these factors, the approach of Li *et al.* (2011) was selected for validating the categorization scheme.

5.2.2 Case 2 (product-based, external context). We could identify four approaches (Han and Park, 2009; Holz *et al.*, 2005; Kankanhalli *et al.*, 2011; Toledo *et al.*, 2011), with only two

of them being relevant for analyzing KMISs with external user context, namely, Holz *et al.* (2005) and Toledo *et al.* (2011). From these two, we finally selected the one of assumable higher scientific relevance (measured by the impact factor of the publishing journal). The approach by Toledo *et al.* (2011) was published in 2011 and represents a typical approach for a KMS with external user context.

5.2.3 Case 3 (product-based, heavy-weight). The relevant literature contains several approaches (Han and Park, 2009; Holz *et al.*, 2005; Štajner *et al.*, 2012; Zhen *et al.*, 2010). From the articles published between 2006 and 2012, we selected two comparable approaches as candidates for validation (Han and Park, 2009; Zhen *et al.*, 2010). Finally, the approach by Han and Park (2009) was chosen for validating the classification scheme, as it includes a more comprehensive overview of the developed functions than the other candidate paper.

5.2.4 Case 4 (product-based, light-weight). Two approaches identified in literature can be considered light-weight in term of information delivery and scientific relevance (Holz *et al.*, 2006; Pai *et al.*, 2013). According to its more recent publication date and the impact factor of the publication, the approach introduced by Pai *et al.* (2013) has been selected for validation.

5.3 Results

We present the results of our validation in the following. For each case, we apply the categorization scheme to the respective approach. For each layer, we describe based on which information the decision for a specific category has been made and whether ambiguities could be identified.

5.3.1 Case 1: Expert recommendation based on fuzzy text classification. The following classification is based on information given in Li *et al.* (2011).

5.3.1.1 Classification Layer 1 (A-B). The mentioned functionality of the system intends enabling communication between the right human actors of an organization. The information needs and expertise levels of the actors are evaluated for specific knowledge areas. Task-specific information is separated neither from the situation, nor the included human actors at any point. Therefore, this approach is suitable for the situational differentiator for Criterion A.

As the mapping of information seekers and experts occurs according to the levels their profiles show in the different knowledge areas, task-specific information is never externalized to the system. Hence, this approach is not suitable for the situational differentiator for Criterion B.

5.3.1.2 Classification Layer 2 (C-D). As the approach is not intending to externalize task-specific information, for example, for redistributing information, the system is not suitable for the situational differentiator for Edge C. Rather, the dedicated goal of this approach is the support of individuals of an organization by connecting them with knowledgeable experts within the organization. Re-contextualization of task-specific information is not executed within the system, but rather through the direct communication of the information seeker and the knowledgeable expert. Accordingly, this system is suitable for the situational differentiator for Criterion D.

5.3.2 Case 2: ontology-driven document retrieval. The following classification is based on information given in Toledo *et al.* (2011).

5.3.2.1 Classification Layer 1 (A-B). This approach is not fostering communication between human actors. It intends to separate knowledge from its original context and to reuse it in different contexts using domain ontologies. Therefore, it is not suitable for the situational differentiator for Criterion A.

Given the mentioned functions of the knowledge representation module, the approach intends to externalize knowledge and information into ontological data sets. Furthermore, it

aims to reuse this information for different knowledge domains. Re-contextualization of information occurs on the basis of a user query. It is executed by the information retrieval module on a data set of ontologically optimized information artefacts. As the system refers to externalizing information and thus resolves re-contextualization with IT methods, it is suitable for the situational differentiator for Criterion B.

5.3.2.2 Classification Layer 2 (E-F). As the user context is defined through the search query of the user and not by the system itself, the approach is not suitable for the situational differentiator of Criterion E. The system obtains the current user context only through the search query entered by the user. Aside to the context information provided by users, no other sources for re-contextualization are available for the system. The queries of the user are matched with documents and information of the system according to its ontological justifiability. Re-contextualization, therefore, occurs via connecting a user query with the ontologically optimized data set. According to these characteristics, this approach is suitable for the situational differentiator for Criterion F.

5.3.3 Case 3: Process-centered knowledge model and enterprise ontology. The following classification is based on information given in Han and Park (2009).

5.3.3.1 Classification Layer 1 (A-B). Because of the described forum and expert consulting features, the approach supports communication and exchange of knowledge between human actors. The idea of externalizing information from its creators and linking it to a specific context is inherent to this approach – the approach is not suitable for the situational differentiator for Criterion A.

As the main ontological features support externalizing knowledge and used within an organization, this approach is focusing on storing information within an information system. Re-contextualization of information occurs within the system because of defined dependencies of concepts and its instances. Accordingly, the approach is suitable for the situational differentiator for Criterion B.

5.3.3.2 Classification Layer 2 (E-F). The specific context of each user can be identified through an instance or process ID retrieved from the user of the system. As this ID as information object only contains a plain identifier, it does not correspond to the concept of context provided by Dey (2001). Consequently, the approach is not suitable for the situational differentiator for Criterion F.

The user context itself is stored within the repository of the system and evaluated according to the current process ID of the user. This ID does not contain any further context defining information but can be used by the system to reconstruct the context of the user. Accordingly, the approach is suitable for the situational differentiator for Criterion E.

5.3.3.3 Classification Layer 3 (G-H). As the approach of Han *et al.* requires an exact ontological concept definition to build up the structure required for information delivery, it shows a high demand for upfront modelling of business processes. Re-contextualization occurs according to either specific process instances or at least specific process concepts that a current user is working in. Hence, the approach is suitable for the situational differentiator for Criterion G and can be denoted as a heavy-weight approach.

Actually, the differentiators for light-weight approaches are contradictory, with respect to upfront modelling effort and differentiator genericity. As already described, the approach by Han *et al.* requires high upfront modelling effort and connects information by specific context definitions. The approach is not suitable for the situational differentiator of Criterion H.

5.3.4 Case 4: Semantic-based content mapping for information retrieval. The following classification is based on information given in Pai *et al.* (2013).

5.3.4.1 Classification Layer 1 (A-B). As the approach does not aim to support communication between human actors, it is not suitable for the situational differentiator for Criterion A. The approach rather intends to externalize knowledge in the form of documents into an information system to deliver it to a user in a later step. Once a document is transferred to the information system, the approach decontextualizes the contained knowledge by extracting its information to a semantic content map. Using methods of semantic content matching, relevant documents are later identified by comparing them to the source document as queried by the user. In other words, this approach externalizes knowledge and intends to solve the problem of re-contextualization through semantic matching. Hence, this approach is suitable for the situational differentiator of Criterion B.

5.3.4.2 Classification Layer 2 (E-F). Information delivery in this approach relies on a reference document that is analyzed to extract the user's current context and deliver information that is relevant in this context. The paper does not give a specific description of the way a document is added to the system. Yet, an upload function shown in the prototypical user interface indicates that the document needs to be uploaded to the system actively from the user side.

The document uploaded by the user is *per se* not a user context definition, but an artefact allowing the system to extract the current user context by semantic techniques. Consequently, re-contextualization is based on information that is created and retrieved through functionalities of the system itself. The approach is suitable for the situational differentiator of Criterion E.

As the actual re-contextualization of information is based on the semantic enhancements and information created within the system, the user context is not solely defined by the information seeker. Hence, this approach is not suitable for the situational differentiator of Criterion F.

5.3.4.3 Classification Layer 3 (G-H). The work of Pai *et al.* (2013) does not require upfront modelling of information sources, as all semantic enhancements are executed automatically within the system. As the differentiators rely on generic differentiators like semantic similarity of content maps, this approach is suitable for the situational differentiator for Criterion H.

Specific meta-information is not required, as each document is analyzed only according to its content. Previous work on comparable approaches has revealed that systems not including task-specific differentiators are not as advanced in generating valid information for complex processes as approaches using those differentiators (Kleinberg, 1999). From these findings, it can be concluded that this system would lack accuracy when being used to capture highly structured information sources and complex process structures. Hence, the approach is not suitable for the situational differentiator for Criterion G.

6. Summary and discussion

The case study presented above helped to validate the classification scheme. We have checked whether the layered and multi-dimensional approach is suited to unambiguously classify KMSs approaches on re-contextualization following criteria derived from OMISs research. For each element, a case stemming from the KMSs field could be identified and the classification could be executed in an exemplary way. We experienced difficulties neither when applying our classification framework nor when extracting classifier-relevant information from the selected studies. We can state that the classification framework appears to be comprehensive, as it has enabled capturing the dimensions relevant to design re-contextualization support identified from OMIS research, such as interaction-centric approaches and context-less and contextual approaches with respect to user information.

Developing a categorization framework in an exploratory way has the benefit of bootstrapping, as each development step is reversible when turning out not to hold for the

next one. There is no influence by existing structures. It also can lead to novel or/and conflicting results with respect to existing work. As the presented work seems to be the first attempt to enrich KMSs research with results from OMISs research on re-contextualization, the main task was to identify coherent classifiers that enable semantically correct representation of content stemming from either field. We could demonstrate that KMSs approaches differ in their attempts to resolve context re-construction similar to the approaches proposed in OMISs research. As re-contextualization seems not have been a perspective considered for the design or selection of KMSs so far, the present research can be considered an initial step towards operationalizing the design space for task/technology fit in KMSs design (Baloh, 2007; Turner *et al.*, 2009).

The results show that the reviewed approaches could be unambiguously classified using the scheme on each layer. Still, the limited amount of approaches included in the case study does not allow claiming generalizability of the scheme. It should be considered a starting point for structuring the field and even potentially allow overcoming the proposed categories by combining different re-contextualization strategies in novel approaches, potentially enabling adaptability to various information needs in different contexts.

7. Conclusions

Classifying KMSs approaches using concepts derived from OMISs research has enabled us to show that our framework has successfully transferred findings from an area of research focusing on the delivery side of KM to the more holistic field of KMS, in which – we have hypothesized based on existing literature – the topic of socio-technical re-contextualization of information has not yet been examined as thoroughly as in the field of OMISs. Adopting the results from OMISs research on this issue could support the operationalization of task-technology fit in KMSs selection or design processes (Turner *et al.*, 2009).

Our first step was reviewing possible categories as found in OMISs literature. They allow for comparisons and analyses based on specific categories of information, such as user-context awareness. We developed these approaches further to an integrated framework capturing various ways of context reconstruction. We could validate the classification scheme applying it to currently state-of-the-art KMSs approaches.

The present work has several limitations. First, the external validity of the empirical design is limited, as the case study only has included five approaches. Still, they have been chosen to provide a diverse selection of re-contextualization strategies in the field of KMSs and, thus, have enabled to validate all proposed classification criteria of the scheme at least once. Second, the generalizability of the scheme is yet to be evaluated. We consider the proposed scheme to be a starting point for research that can be extended in terms of re-contextualization strategies or might require considering further structuring dimensions emerging during future research. Third, the practical implications of applying the scheme have not yet been examined. At the moment, we only have indicative evidence that a structured approach to KMS classification will enable a more informed selection of KMS appropriate for a particular real-world organizational work situation.

Consequently, our work so far allows structuring and comparing approaches that are relevant for developing KMS that explicitly consider the issue of re-contextualization in an attempt to increase their immediate operative added value. Further research concerns extensive application and in-depth studies of information systems being relevant for organizational memory systems, for example, systems-thinking support systems. The framework itself should allow adding further dimensions in case further challenges should be incorporated when informing KMS development.

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