Towards a Knowledge-based Framework for Enterprise Content Management

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Abstract

Nowadays, critical information that is contained in mostly unstructured documents is increasingly becoming a key business resource. Accordingly, enterprises need a foundation for managing content to understand its value and transform it into information and organizational knowledge. Enterprise Content Management (ECM) is an integrated approach to Information Management. There is a need for enhancing this approach to support the transformation from information into organizational knowledge. However, assessing, organizing, sharing, and using content based on knowledge perspectives are crucial, especially for knowledge-intensive enterprises. Those enterprises provide knowledge-intensive products and services that require a robust foundation for knowledge management and innovation capacity. We present the KBCM (Knowledge-Based Content Management) framework for ECM based on the perspective of knowledge components. This paper seeks to create more business value by transforming content into valuable information assets and then from information into organizational knowledge. To demonstrate the framework, an illustrative example is constructed and evaluated.

1. Introduction

Today, enterprise content is growing at a rapid speed and is covering the majority of business information. Since unstructured content makes up 80% of the total data [31], it still presents a challenge to companies for managing and using this content. Huge amounts of content are produced every year and need to be captured, managed, stored, preserved, and delivered efficiently on an enterprise-wide scale [2]. However, content is usually only means to an end: it contains business information. For companies, especially knowledge-intensive enterprises, information is a driver of business in general and innovation in particular. One step further, the accumulation and the application of information lead to organizational knowledge. Companies want to make use of business-critical information, which often resides scattered across several repositories and systems. To be able to perform efficiently and to make good decisions, employees need to have access to organizational knowledge and to the right information at the right time. As a matter of fact, employees cannot make good decisions when they are time-stressed and overloaded with information [15].

Enterprise Content Management (ECM) has evolved as an integrated approach to Information Management (IM) [34]. It enables the management of content on an enterprise-wide scale. Nowadays, more and more companies adopt commercial ECM solutions, which are becoming more mature and sophisticated. While ECM received a lot of attention from practitioners [52], it only received little attention from academic research [37]. Since ECM is still an emerging field in Information Systems (IS) research, more research needs to be carried out in order to add more value to this approach [37][52].

In the case of knowledge-intensive enterprises, an integration of ECM and Knowledge Management (KM) is indispensable. Knowledge-intensive enterprises, as opposed to labor-intensive or capital-intensive enterprises, can be preliminary defined as organizations that offer the use of fairly sophisticated knowledge or knowledge-based products and services to the market [4][32]. Effective knowledge flows and KM can drive innovation; therefore, managing knowledge inside ECM systems, within and between enterprises, has become a vital factor.

Within this paper, we investigate how enterprise content can be assessed and classified based on the perspectives of knowledge components. The remainder of this paper is organized as follows: Following the introduction, the paper begins with research design and literature review. Then, a framework called KBCM (Knowledge-Based Content Management) for enterprise content classification based on knowledge components is introduced. Within an illustrative example, the research artifacts are checked. The paper ends with a short discussion and conclusion with implications.

2. Research design

This paper seeks to answer the following research question: *How can enterprise content be assessed and classified based on the perspective of knowledge components to transform content into organizational knowledge?*

The research design of this paper consists of two phases: i) the design and evaluation of the research artifacts and ii) a subsequent pre-test of them.

Within the first phase, the actual construction of the artifacts was the focal point. To ensure rigor within the research process, relevant literature has been reviewed [21]. Concerning the research process and methodology, we chose design science research to explore our research question [17]. Design science research is particularly useful for creating and evaluating IT artifacts that intend to solve identified organizational problems [16][17]. Key recommendations [23] and guidelines [16][17] for this research method have been used in this context. Furthermore, certain advice on performing the actual research process has also been used [33]. The outcome of the iterative design and evaluation procedure are research artifacts with different levels of abstraction. Those artifacts represent several components such as a set of constructs, a model, a method and a set of instantiations [23][47]. The constructs are different types of concepts related to content and knowledge produced and used in ECM systems. The model is a set of statements expressing the relationships between content and knowledge concepts. The method is a set of activities supporting the process of content management and knowledge development. The instantiations are best practices related to the operationalization of the framework.

The second phase of the research was the pre-test of the research artifacts. We have used analytical and descriptive evaluation methods to examine the static qualities of the artifacts (KBCM framework) and for building arguments to describe its utility [17]. To refine the evaluation process within the design science research cycles, an illustrative but realistic example was constructed and tested. Due to space limitations, only an excerpt of the comprehensive illustrative example is presented within this paper.

3. Literature review

In this section, we outlined firstly the foundations and key aspects of ECM and then performed a comprehensive literature review concerning KM in ECM systems within the IS research domain.

Enterprise Content Management. While IM and KM are well-studied topics in IS literature, ECM received little attention from scholars yet [50] and limited academic research has been conducted. The importance of ECM for IS research, however, is emphasized by [46]: "[…] ECM provides an important and complex subfield of Information Systems".

In contrast to the moderate academic attention, ECM received much attention from practitioners [49]. It is a popular and important topic among companies: The market for ECM software, services and consulting is booming; it "has been one of the fastest growing areas of IT" [25].

Since the introduction of the concept around the turn of the millennium, it is still not perfectly clear, what lies beyond ECM [42]. There is not a well-established and accepted definition. From a practical point of view, ECM is defined as "[…] the strategies, methods and tools used to capture, manage, store, preserve, and deliver content and documents related to organizational processes. ECM tools and strategies allow the management of an organization's unstructured information, wherever that information exists." [2]. From an academic viewpoint, ECM is summed up as an integrated approach to IM [34].

Information Management, Knowledge Management and Enterprise Content Management. In our point of view, the overlap of ECM, IM and KM is that all three approaches focus on data and information. Particularly, ECM focuses on enterprise content, a typical type of mostly unstructured data. IM focuses on information that is inferred from data that could be found in ECM as well as other enterprise systems. KM focuses on the transformation of information into organizational knowledge.

As a matter of fact, ECM providers focused on the technology perspective that addressed generic technological ideas rather than the content perspective or organizational context of technology utilization [46]. Within ECM literature, there are some efforts to add more value to ECM systems by integrating enterprise content with information or process management. There is an approach that aims at applying a business process perspective on ECM systems and studying experiences of those initiatives [50]. Another perspective considers enterprise aspects such as organizational, social and business issues of content management [45].

In our observation, ECM still focuses on IM at the technological level. Therefore, in order to support continuous improvement and innovation, ECM needs to provide a new facet that supports KM. In this perspective and as a multifaceted topic, ECM emerged from several related, preceding approaches and disciplines. While previously various concepts simultaneously coexisted within the IS infrastructure of companies, ECM integrates them on an enterprise-wide scale and helps to eliminate content silos. Web content management,

document management, records management, digital asset management, IM and KM can be consolidated in a homogeneous ECM architecture [2].

Reconciliation of KM and ECM. As mentioned above, there has been an effort to reconcile IM and ECM [15]. Concerning the reconciliation of KM and ECM, although the top-down vision for ECM includes a better use of valuable information, improvement of decision-making and creation of competitive advantage, most ECM initiatives take a bottom-up approach that focuses on delivering immediate benefits such as enterprise portals, information sharing, and web content management [42].

Taking into account the booming of content in enterprises and in networks (e.g. big data) as well as the current challenges to decision-making [15], there is a need for the reconciliation of KM and ECM. To our best knowledge, little research has been conducted to this direction, especially concerning the theoretical foundation for content classification based on organizational knowledge [38]. We believe that this foundation is vitally important for improving decision-making, promoting knowledge development and enhancing innovation capacity.

For this reason, this work sets out to address this by developing a knowledge-based framework for assessing and managing enterprise content based on the perspective of knowledge components. In this paper, we present the KBCM framework which aims at proposing a new facet for ECM architecture to support knowledge development and creation of intellectual capital [28]. As a matter of fact, ECM literature has set the basis for management of content such as granular data, documents and information. Building up on this, KM literature was the foundation for the management of knowledge assets and organizational knowledge. Selected studies about KM and KM systems [3] and the tacit-explicit model [29] built an important basis for our own research aims. Tacit knowledge is knowledge resting with employees and explicit knowledge is knowledge in ECM systems. For this reason, the KBCM framework needs to support different knowledge conversion activities to transform knowledge from one form to another such as combination, internalization, externalization and socialization [29].

Our research bases on the resource-based view and the knowledge-based view of the firm. The resource-based view of the firm originates from [5][35][51] and states that resources such as knowledge can lead to the creation of competitive advantage. The knowledge-based view of the firm [11] builds upon and extends the resource-based view of the firm and emphasizes the importance of knowledge as a strategically significant resource to achieve competitive advantage. KM should involve the learning process of individual and collective members of an organization or a network of organizations [30]. Thus, KM approaches need to promote the intellectual capital that refers to the knowledge and knowledge processes of a social entity [43][44].

The problem that motivates our research study is the lack of the capacity of effective KM in ECM systems. Indeed, nowadays companies have faced the challenges such as the increasing number of collaborators and of information resources as well as the shrinking decision times [15]. Therefore, they need to know, where information and valuable knowledge reside to make use of it efficiently. Content assessment is a comprehensive task which needs to be performed in a structured way. Assessed content needs to be classified and finally transformed into organizational knowledge.

4. Knowledge-Based Content Management framework

In accordance with design science research, the IT artifacts proposed by the KBCM framework include a set of constructs, a model, a method and a set of instantiations [47]. In general, the framework covers two facets: the traditional IM facet and a new KM facet. Some of its concepts have been enhanced from the industrial standards for ECM architecture such as OASIS DITA [14] and TOGAF [48] in order to support the IM facet. Besides, other concepts are adapted from [20] to support the perspective of knowledge components for KM in ECM systems.

4.1. Constructs of the KBCM framework

The constructs of the KBCM framework are different types of concepts related to IM and KM facets. According to our literature review, the objective of ECM systems is to support and manage content objects [14][48]. These content objects can be assembled into different information products, which can be delivered to different types of target users [24].

The content that resides in ECM systems can be viewed according to three perspectives: information view, user view and system view [37][46]. Those perspectives can be defined as follows: i) the *information view* deals with the semantics of the content; ii) the *user view* focuses on the interaction between the user and the system, including the creation, usage and management of the content; and iii) the *system view* deals with the container in which content resides. In addition to that, the KBCM framework suggests a new view: the *network view* represents the way of collaborating on content in a network. In the following, the constructs of the framework are presented according to these views of the content.

4.1.1. Information view. The information view deals with the semantics of the content and covers three aspects of information: the static, the dynamic and the rule aspects [19]. The static aspect of information concerns the structure of information and relates to the knowledge of what. The dynamic aspect of information aims at the transition of information and relates to the knowledge of how. The rule aspect is on the meta-level of the two previous concepts, concerns the coherence of information structure and information processing, and relates to the knowledge of why [20]. Accordingly, the following constructs are related to the information view: content object, knowledge component, know-what, know-how, and know-why.

Information and knowledge resources are created by authors and are stored as content objects in ECM systems. Each content object corresponds to a subset of knowledge components and is classified according to its knowledge components so as to be transformed into useful information later. A knowledge component is a form of knowledge such as know-what, know-how and know-why [10].

Know-what is often generated through 'learning-by-using' and describes knowledge artifacts known related to a phenomenon of interest [10]. In an organization or in a social network, know-what often refers to products, services, and other organizational properties. The know-how is generated through 'learning-by-doing' and describes the understanding of the generative processes constituting phenomena [10]. Know-how knowledge components in ECM systems are usually related to business processes such as sales and marketing, production and logistics, accounting and finance. Thereby, business processes are not only regarded as manual, semi-automatic or automatic activities that are performed to achieve organizational goals, but as the "know-how-platform of an organization" [18]. Know-why is obtained through 'learning-by-studying' and describes the understanding of principles of the underlying phenomena [10]. In ECM systems, a know-why knowledge component often refers to business rules that are put in place to help an enterprise achieve its business goals and comply with laws and regulations. Rules can apply to the constructs related to know-what or know-how.

4.1.2. User view. The user view aims at supporting the interaction between the user and the system. It involves the steps and decisions undertaken by a user to achieve tasks using semantic units of information [7]. The scope of these units is determined by corresponding zones of responsibilities. The constructs related to the user view are: know-who, semantic unit of information, and zone of responsibilities (ZoR).

Know-who refers to individuals, groups or organizations that may provide or consult the content objects [20]. A semantic unit of information depicts the semantic context of an application of information and knowledge in a particular situation. A semantic unit of information is defined as a coherent representation of the whole structure, transition and coherence of information. In other words, a semantic unit of information includes a set of interconnected know-what, a set of know-how that uses methods belonging to these know-what, and a set of rules whose scope is defined within these know-what and know-how. Each know-who may assure a ZoR that determines the relationships between know-who and other knowledge components. For instance, a ZoR may determine who-know-what, who-know-how and who-know-why.

4.1.3. System view. The system view deals with the containers in which content objects reside. The constructs related to the system view are: information product, know-where and know-when.

An information product assembles different content objects to deliver to its target audiences [31]. For example, reports, brochures, press releases or presentations are popular information products found in business. In order to identify and locate information products throughout an organization, information about how an enterprise organizes and handles its content is needed, which is represented by know-where and know-when knowledge components. Know-where indicates where the information product is and its locations in various information systems. Know-when relates to the sense of timing that gives the right time for finding an information product. Know-where and know-when help people to know the best time for finding the right information in the right place.

4.1.4. Network view. The network view concerns the way of collaboration between the organization and its partners in a network. The constructs related to the network view is know-with, shared object, overlap situation and overlap protocol.

The know-with is the knowledge about the way of collaboration with partners in a network environment. Know-with is defined based on a shared object, an overlap situation and an overlap protocol. A shared object is an information product that is intended to be shared between members of a network. An overlap situation occurs when there is at least one shared object that is common to different ZoRs. An overlap protocol can be used to handle overlap situations [20]. In a network, overlap protocols aim at allowing each ZoR to perform its own processes locally but also to be able to be aware of the processes in other ZoRs, which can influence its own processes.

4.1.5. Example. To check the KBCM framework within a pre-test, an illustrative example was constructed and evaluated. This example has been inspired from one of our projects. In this way it is demonstrated, how the framework can be used to analyze ECM and KM activities in an organization and develop improvements based on identified deficiencies. A knowledge-intensive enterprise named *PM-Coordination* serves as a realistic example. This company offers consulting services in the area of project management. The enterprise is interested in capturing its knowledge about project deliverables (know-what), project activities (know-how), and legal obligations (know-why) which need to be considered in its projects.

Information view: The enterprise uses the *glossary* function for representing the know-what, the *web pages* for representing the know-how and the *discussion forum* for the know-why.

User view: There are four types of know-who that are represented by different categories of users: Anonymous user, Authorized users, Moderators, and Super users. Anonymous users (such as partners, clients or suppliers) may visit certain web pages. Authorized users (such as employees) can refer to glossary items, visit all web pages, and consult and reply forum postings. Moderators (such as managers) can edit or delete the glossary items, web pages and forum postings according to their responsibilities. Super users (such as directors) can appoint moderators. A semantic unit of information is defined for the PMO (project management office) of *PM-Coordination* that manages all the construction projects. The manager of PMO will play the role of a moderator and manage the zone of responsibilities related to this semantic unit that covers all the knowledge related to construction projects.

System view: There are two information products related to the *glossary*: an online version and a paper version for training new employees at the beginning of each year. There are three information products related to *web pages*: a web site of the enterprise, a web page on Facebook, and one on LinkedIn. Besides, there is a special information product in form of *wiki pages* that summarizes the knowledge of what, of how and of why. Concerning know-when and know-where, each page of the wiki has information about the date and the location of the latest update and the application scopes.

Network view: The wiki pages can be shared with clients, suppliers and partners who can view the pages but cannot modify the content.

4.2. Model of the KBCM framework

The objective of the model of the KBCM framework is to express the relationships between the concepts of the KBCM framework, especially the concepts related to the IM and the KM facets. The meta-model of the KBCM framework is specified using simplified Unified Modeling Language (UML) notation [40]. Some concepts of this meta-model are inspired by [20] and were further enhanced.

4.2.1 Information view. In an ECM system, an information product contains a subset of content objects (Figure 1). Each content object relates to one or several knowledge components. As stated before, there are three types of knowledge components: know-what, know-how and know-why. A know-what deals with the structure of information that is represented by a class. A class in turn has certain attributes, methods and dynamic states [19].

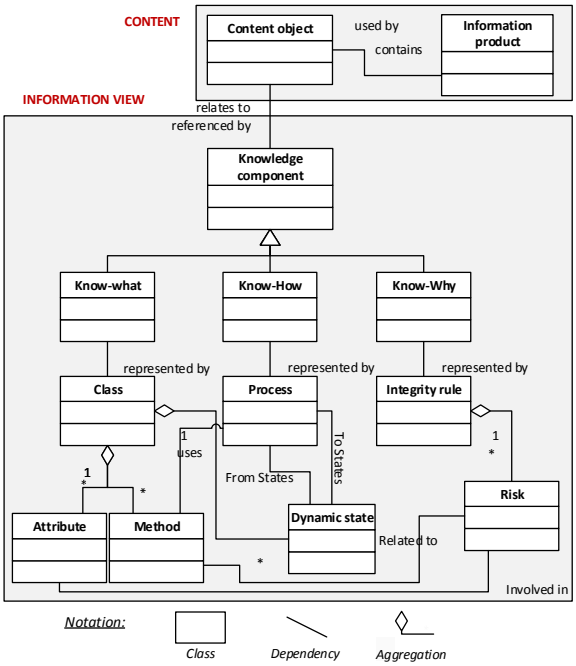

Figure 1: Excerpt of the meta-model related to information view.

Further, a know-how concerns the transition of information that is represented by a process. A process in turn invokes a set of methods and changes a set of dynamic states of classes. Finally, know-why concerns the coherence of information that is represented by an integrity rule. An integrity rule in turn manages a set of risks. Each risk is related to certain methods and involved in some attributes of classes.

4.2.2 User view. An information product is created based on a semantic unit of information (Figure 2). A semantic unit of information depicts a context of content and knowledge application in a specific situation.
A semantic unit of information includes a set of processes that use methods belonging to these classes, a

set of interconnected classes, and a set of rules whose risks are defined within the classes. A ZoR is a part of an organization that assumes a responsibility for information inside a semantic unit. The know-who is a knowledge component that refers to either groups or individuals who assume a ZoR.

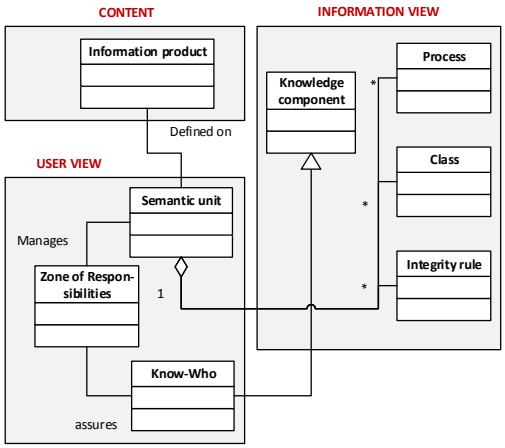

Figure 2. Excerpt of the meta-model related to user view

4.2.3 System view. At this level, there are two new knowledge components: know-where and know-when (Figure 3).

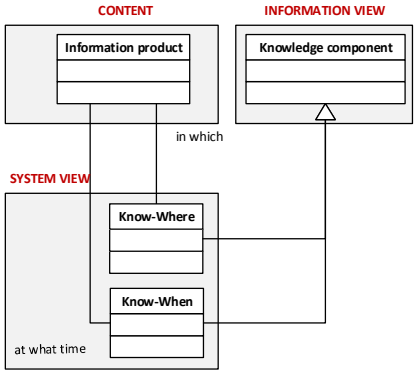

Figure 3. Excerpt of the meta-model related to system view

Each information product is organized and used based on its relevant know-where and know-when knowledge components. Know-where is the knowledge for navigating and finding the right information product. Know-when is knowledge about the timing of events related to information products.

4.2.4 Network view. Know-with is a knowledge component that represents the way of collaboration between members of a network. A know-with is defined by a shared object, an overlap situation representing the information dependencies between ZoRs, and an overlap protocol that operates the overlap situation (Figure 4). An information product assembled by several shared objects can use different delivery methods to reach its audiences.

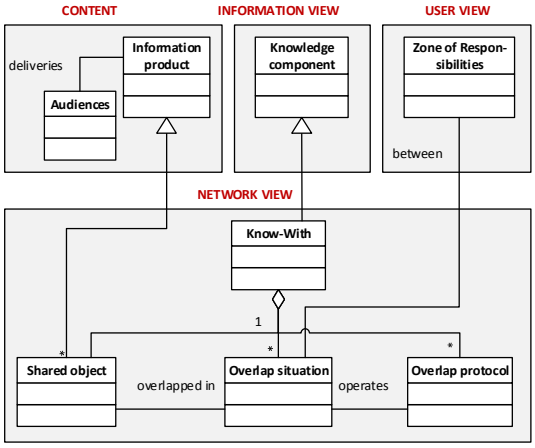

Figure 4. Excerpt of the meta-model related to network view

4.2.5 Example. Let's discuss instances of knowledge components captured and used at *PM-Coordination.*

Information view: There are certain instances of know-what knowledge component in form of a glossary. Those know-what components concern the project deliverables such as *Gantt diagram*, *PERT diagram*, *Status report*, *Project definition*, and *Learned lessons*. Each know-what has its own structure. For instance, the class representing the *Project definition* includes the following attributes: *Project ID*, *Project Scope*, *Project Priorities*, and *WBS* (Work Breakdown Structure). There are also instances of the know-how knowledge component in form of web pages that concern project activities such as *Project defining*, *Project planning*, *Project executing* and *Project closing*. The process related to *Project defining* uses the following methods of the *Project definition* class: *Defining project scope*, *Determining project priorities*, *Defining WBS*, *Integrating WBS with organization diagram*, and *Coding WBS* [12]. Finally, there are some instances of the know-why knowledge component that relate to legal obligations of construction projects. For example, there is a know-why about working hours: "*the working hours of each member of projects could not be beyond the weekly maximum*".

User view: This semantic unit covers all knowledge related to project deliverables, processes and rules. The manager of PMO has the responsibilities for all the information products related to this semantic unit.

System view: The *wiki* as an information product has been created in order to share knowledge between members of PMO.

Network view: The PMO also uses the wiki to share its knowledge with its partners, clients and sup-

pliers. Some partners can consult the wiki pages and submit change requests to the PMO.

4.3. Method of the KBCM framework

The method of the KBCM framework is a set of activities supporting both the process of content management [13] and knowledge development [20]. The process of content management includes the following key activities: assessing, organizing, sharing, and using [13]. Meanwhile, the process of knowledge development includes the knowledge creation, knowledge organization, knowledge transfer, and knowledge application activities. Since the objective of our approach is to propose a new facet for ECM systems, we adopt the process of content management for the method of our framework and then integrate it with the process of knowledge development (Figure 5).

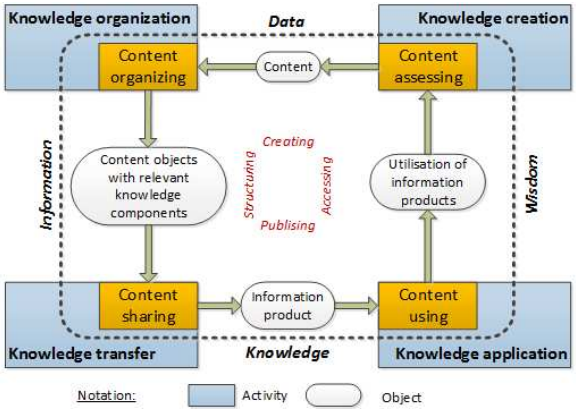

Figure 5: Method of the KBCM framework.

In Figure 5, the knowledge hierarchy is depicted, which also stands for the data-information-knowledge-wisdom hierarchy (DIKW) [39]. In our approach, we focus on enterprise content, a typical type of mostly unstructured data. Information is data that is processed to be useful and provides answers to what, who, when and where questions. Knowledge is the application of data and information and provide answers to how questions. Wisdom is an evaluated understanding and provides answers to why questions.

4.3.1 Content assessing. The objective of the content assessment activity is to develop new content or to improve existing content within the organization's body of knowledge. This activity creates or acquires valuable content from different sources inside and outside ECM systems. Content from outside of ECM systems will be transferred into ECM systems in order to be (re-) organized.

4.3.2 Content organizing. The content organization activity aims at corresponding enterprise content together with relevant knowledge components in order to transform them into useful information. This activity structures content by editing and transferring it into content objects and adding semantics through metadata concerning relevant knowledge components (know-what, know-how and know-why). Content objects are organized according to their semantics (semantic unit of information) and corresponding sources (i.e. ZoR).

4.3.3 Content sharing. The content sharing activity occurs at different levels: individual, organizational and social levels. This activity extracts content objects from ECM systems, assembles them into information products and then transforms information products into targeted publications using different delivery methods (web site, email, numeric documents, etc.). The knowledge components related to information products, such as know-where and know-when, also need to be indicated in order to identify and locate information products in ECM systems. Information products then become organizational knowledge which enables organizational learning and promotes the development of intellectual capital [28].

4.3.4 Content using. The objective of the content using activity is to apply the organizational knowledge to a special use or purpose. This activity will identify the way of collaboration with regard to business content within and between organizations. It will determine what content needs to be shared (shared objects), the business context or situation (overlap situation), involved audiences (know-with) and the way of working (overlap protocol). To transform knowledge into wisdom, it is vital to consider the primary mechanisms for knowledge application such as directives, organizational routines, or self-contained task teams [20].

4.3.5 Example. The KBCM-based system for *PM-Coordination* is represented in Figure 6.

Content assessing: *PM-Coordination* has installed an open-source ECM software and built a KBCM-based system, which has been designed to leverage the knowledge repositories based on the components and makes use of knowledge available on the Semantic Web [6]. This solution allows the enterprise to create a document library that is a collection of common documents for its projects that could be shared among team members. Members can use their browsers to find the documents, consult them, and make comments.

Content organizing: The enterprise has organized its content according to the perspective of knowledge components. Content related to deliverables correspond to know-what that can be used to create a glossary. Content related to activities correspond to know-how that can be used to create the web pages. Content

related to legal obligations correspond to know-why that can be transformed into a discussion forum.

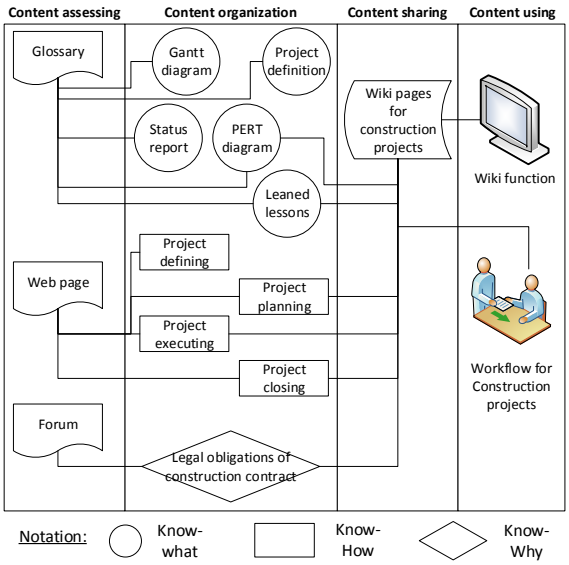

Figure 6: The KBCM based system for PM-Coordination.

Content sharing: In order to collaborate efficiently with its partners, suppliers and clients, *PM-Coordination* creates an information product in form of wiki pages that summarizes all knowledge related to project deliverables, project activities and legal obligations. The wiki pages have been organized according to the types of projects (construction, information technology, business development, etc.) and the semantic units of information (e.g. the relationships between knowledge components). Each type of project is supervised by a specialist in this area.

Content using: The wiki pages are published in a function (similar to Wikipedia) that links to glossary items, forum postings and web pages. In general, partners, clients and suppliers can view the wiki pages, but they cannot modify them. However, some partners can make change requests. There is also a search engine so that content can be searched based on keywords, time, or location. Furthermore, PM-Coordination uses the workflow function to enforce the automatic routing of documents used in its services so that one can easily learn and apply the organizational routines.

5. Discussion

Our approach aims at proposing a new facet of KM for ECM systems based on the perspective of knowledge components. This perspective allows our approach to support different types of innovations in organizations. With the illustrative example, we intend to show that the artifacts are able to help enterprises with the complex task of assessing, organizing, sharing, and using content based on knowledge perspectives. The pre-test of the artifacts or the KBCM framework includes analytical and descriptive evaluation methods [17]. Concerning the analytical method, we have used the static analysis and examined the structure of the artifacts for static qualities and explained how the proposed artifacts can be used. We also used the architecture analysis to study how the artifacts could be integrated into an IS architecture, especially the open architecture such as open source ECM systems [6]. Concerning the descriptive method, we have built certain detailed scenarios around the proposed artifacts to demonstrate its utility.

Knowledge can be classified according to its level: individual knowledge, organizational knowledge, and collective knowledge [43]. Accordingly, KM approaches can manifest themselves as intellectual capital in its three forms (human, organizational, and social capital [44]) which covers the knowledge of individuals, of an organization, or of a network of organizations. In the KBCM framework, the different views of knowledge components represent the different types of knowledge in an organization.

Furthermore, innovations can be classified based on technological, market and administrative characteristics [1]. *Technological innovation* is the knowledge of components, linkages between components, processes and rules that go into a product or a service [36]. *Market innovation* refers to the knowledge about distribution channels, product equipment and customer expectations [1]. *Administrative innovation* relates to strategies, structure, systems or people [36]. We believe that those types of innovation require different types of knowledge used in organizations. This is the reason why we adopt the perspective of knowledge components [10][20] that covers different types of knowledge, called knowledge components, such as know-what, know-how, know-who, know-why, know-when, know-what and know-with. Depending on the context of application, each type of innovation requires a subset of knowledge components.

We did identify certain limitations within our approach, especially with regard to the empirical validation and completeness of the framework. To test the framework, we successfully evaluated the artifacts within a pre-test in the form of an illustrative example. Further empirical validation of our approach seems useful. We argue that our approach is comprehensive and applicable; however, we do not claim that it is entirely complete for all circumstances. Especially in specific business contexts and special cases, adjustments can be necessary. Furthermore, KM involves various aspects such as socio-cultural, organizational, and technological aspects [22]. We address here the

technological aspect. More precisely, we enhance the ECM architecture to support different KM activities.

6. Conclusions and outlook

Our approach is one of the first that focuses on applying a knowledge perspective on ECM by proposing a theoretical foundation for content assessing and managing based on the perspective of knowledge components. Based on our research question, we proposed a knowledge-based framework for assessing, classifying, and managing enterprise content, called KBCM framework. According to the design science research principles, we designed and evaluated artifacts using UML. As defined in design science research [23], the framework consists of different artifacts with different level of abstraction: construct, model, method, instantiation. The objectives of this framework are to analyze and optimize the interplay of ECM and KM, add more business value to ECM systems, promote knowledge development, and enhance intellectual capital.

With regard to practical and theoretical implications, our approach aims at linking knowledge and enterprise content management. Due to the different levels of views, we suggest that the artifacts of our framework could be adapted to several real-world scenarios whereas each view could be more and less important. Integrating KM within the ECM context with our knowledge-based framework can help practitioners to make better use of their content and information assets and to accumulate organizational knowledge. When an enterprise intends to use an ECM system¸ the KBCM framework provides a starting point to assess and organize content according to their knowledge components, and then share content within and between organizations. From an academic point of view, the suggested approach can be applied and refined by researchers to improve its generalizability and broaden its scope. Moreover, the integration of the IS research disciplines such as KM and ECM and the future development of those two disciplines within the IS research domain play a vital role in the knowledge economy.

Next to the classic design science research literature, we have foreseen the use of qualitative research methods within this context in our future work [9][27]. Currently, we are working on experimenting and further validating the approach with knowledge-intensive organizations based on the guidelines of design science research and especially observational and experimental evaluation methods. A controlled experiment has been performed in a university research center to study the artifacts in a real-world environment for usability. We are also conducting a case study with an IT company to study the artifacts in depth in a network environment.

In addition, we will investigate the transformation from business-oriented views to more formalized views. One possible direction thereby is to use formal meta-modeling approaches, e.g. [8] to create an IT-based conceptual modeling method based on the above meta-models. In this way, a further evaluation in the sense of creating an artifact that can be applied to real-world scenarios is envisaged [17].

We believe a framework for KM should address all the three aspects of KM: technological, organizational, and social-cultural aspects. For this reason, the social-cultural and organizational aspects will be an interesting direction of research in the future. We believe that the organizational aspect of KM in ECM systems could be based on the activities and practices related to the organizational readiness [41] and the "tacit-explicit" model [29]. Each knowledge conversion activity may use various types of activities and resources of ECM systems. Concerning the social-cultural aspect, we intend to extend the network view of the KBCM framework in order to cover different collaboration styles and network structures in an innovation system or in a business ecosystem [26].

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