Towards an Integrated Approach to Assess the Potential of an Enterprise to Mature Knowledge[1]

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Abstract: In this paper we describe a multi-dimensional framework for knowledge maturing and learning. The framework consists of seven dimensions and supports the assessment of the knowledge management as-is-state in a company as well as the selection of appropriate approaches and methods for a further improvement. The paper also discusses the relationship to comparable approaches (e.g. intellectual capital statements) and ends with open issues for a proper implementation of the maturity framework.

1 Introduction

In this paper we are going to present an integrated approach for assessing the context of an enterprise in order to identify appropriate methods and tools for knowledge maturing and learning.

This approach was derived from conducted knowledge management projects (mainly in the area of process-oriented knowledge management and ontology based information and knowledge management) and will be verified and if necessary adapted within the MATURE project.

Knowledge maturing has been identified by Schmidt as a unifying concept for knowledge management and learning [Sch05]. It illustrates the development from new ideas to consolidated knowledge. The maturing can be supported by methods and tools well-known from knowledge management like knowledge identification, sharing, acquisition, or generation.

[1] This work has been conducted within the EU-funded Integrating Project MATURE (grant no. 216346)which investigates knowledge maturing as new form of learning in businesses and organisations, a dynamic view on e-learning and knowledge management.
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However, when starting projects and initiatives for knowledge maturing and to assess the potentials of these initiatives, questions like the following have to be answered: Where do we stand with regard to knowledge use and learning? How can we support and improve knowledge maturing? What are appropriate learning methods for our company? Which methods and tools can be applied in our environment?

The answers to these questions depend on a variety of influencing factors. In this paper we present a multi-dimensional framework to assess the potentials for knowledge maturing. However, we do not investigate the whole set of knowledge transformation processes from [NT05] , but focus on transforming from explicit to explicit knowledge.

A lot of research is dedicated to a proper treatment of implicit knowledge in a company (e.g. the KMDL® approach [GF06], where knowledge transformation processes in a business process context are investigated.), but comparable little research deals with sophisticated concepts for maturing existing explicit knowledge. Therefore we focus on explicit knowledge (i.e. documented knowledge) in any form.

In section 2 the different dimensions are described in detail. In section 3 we compare our framework with intellectual capital statements. In section 4 open issues are mentioned.

2 Dimensions of Knowledge Potentials

In the following our framework for assessing knowledge potentials is described. The framework distinguishes seven dimensions (see Figure 1).

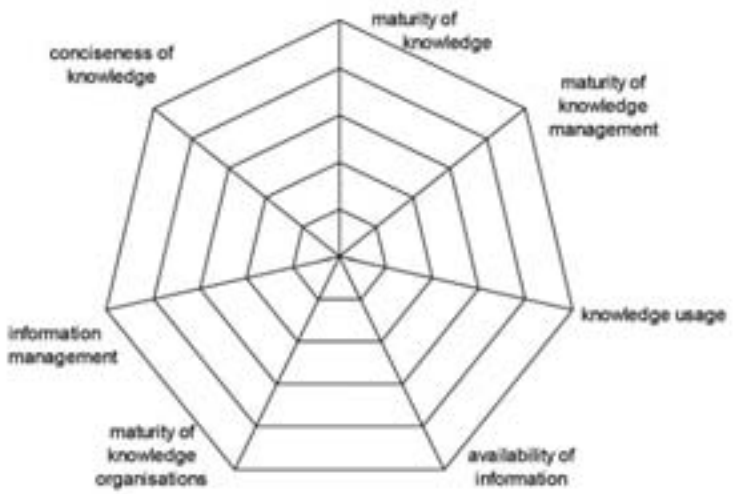

Figure 1: The Seven Dimensions of Knowledge Potentials

This framework can then be used to select appropriate methods and tools by assessing the current situation of an enterprise. This can then be compared to the requirements of the tools as shown in Figure 2.

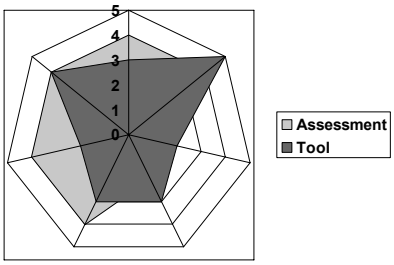

Figure 2: Comparing Assessment of Knowledge Potentials with Tool Requirements

For each dimension we defined various levels which are described in more detail in the following subsections.

2.1 Maturity of Knowledge

The knowledge maturing model views learning activities as embedded into, interwoven with, and even indistinguishable from everyday work. Knowledge is continuously repackaged, enriched, shared, reconstructed, translated and integrated across different interlinked individual learning processes. During this process knowledge matures by becoming less contextualized, more explicitly linked, and easier to communicate. The knowledge maturing model structures this process into five phases [Sch05, MS07]:

(1) **Emergence of ideas** – New ideas are developed by individuals from personal experiences while working on a problem, challenging a solution or in highly informal discussions, e.g. in a coffee corner [TKE01]. Most often ideas are captured in an unstructured way in private notes, stored on personal computers or drives, and eventually spread. The vocabulary is vague and usually restricted to the originator. However, giving room for expressing, discussing and working on ideas is the first step in this knowledge dimension. Thom and Etienne are calling this the ‚innovative climate' of a company, fostering capacity and capability for innovation [TE00].

(2) **Consolidation in communities** – To reach the next level of maturity ideas need to be expressed in a "company's terminology". The development of common terminology shared among community members, e.g., in discussion forum entries, blog postings or wikis is an important step for the maturity of knowledge. As Deshpande, de Vries and van Leeuwen explicate, "Shared understanding is an objected state achieved through interactive processes by which common ground between individuals is constructed and maintained" [DVL05]. Determine the terms and creating a mutual knowledge basis of beliefs and assumptions are core activities of that maturing level.

(3) **Formalizing** – Artefacts created in the preceding two phases are still highly subjective and embedded in the context of the community. However, to avoid the risk of 'new information silos' and team isolation [McD98], knowledge is to be formalized based on company wide used and binding forms or models. In this phase,

purpose-driven structured documents are created, e.g. project reports, design documents or process models in which knowledge is 'de-subjectified' and the context is made explicit. Formalizing of knowledge is a crucial step in the maturing process as it is premise for automation.

(4) **Ad hoc training** – Making knowledge explicit and well organised/structured in a company wide understandable manner is necessary but not sufficient. Employees have to be informed about the new knowledge, about its content, its usage, its importance, its availability etc. The material is ideally prepared in a pedagogically sound way, enabling broader dissemination, e.g. service instructions or manuals. "Organisations that are able to transfer knowledge effectively from one unit to another are more productive and more likely to survive than those that are less adept at knowledge transfer" [Ar00].

(5) **Standardization** –The highest maturity phase is reached when knowledge becomes a standard (within the company) and its usage becomes a must. For this a quality assurance process has to be accomplished and again transformation could be necessary, for example into business rules, such that the new standard can be communicated and its compliance checked. As a consequence, this knowledge becomes teachable to novices. Tests and certificates must be developed to confirm that participants of formal training have achieved a certain degree of proficiency.

2.2 Knowledge usage

The knowledge usage dimension assesses the integration of knowledge management activities into the operational work. This dimension corresponds to the integration of process and knowledge management which is the main focus of process-oriented knowledge management [AHMM02].

(1) **General-purpose storage and retrieval** – On the lowest level there is no integration of knowledge management with the daily work processes. Finding relevant knowledge is supported by general-purpose search engines. To share information, users can use email and collaboration tools that are not integrated in the working environment.

(2) **Fixed link between processes and information objects** – On the second level, there are explicit links between application environments and information objects. This is similar to context-sensitive help systems. In the context of business process management this level is satisfied by process modelling tools which add concrete document models like checklists or forms to process activities.

(3) **Context-dependent knowledge retrieval** – At this level, there is context-specific support for finding relevant knowledge and information. As an example consider search forms with predefined attributes. For example, to search for similar cases in the context of health insurance underwriting, search criteria might be the gender and age of the person and disease, while in the context of claim processing the disease and the volume of the claim are search criteria.

(4) **Context-dependent, automated knowledge provision** – This level extends the context-dependent knowledge retrieval by presenting context-sensitively selected information sources to a user accomplishing knowledge-intensive tasks in a business process. This means that the system has access to the application data. In the example of health insurance underwriting the system could present all regulation and previous cases that are similar to the current one.

(5) **User-specific and context-adapted knowledge assistance** – The highest level in this dimension would be reached if the knowledge provision would adapt to the user. Using again the example of health insurance underwriting, the system would take into account the level of expertise of the user and also would rank the cases depending on previous knowledge access. For example, new information would be ranked higher than information the user had read in previous situations.

2.3 Maturity of Knowledge Management

The maturity of knowledge management is related to the quality of the knowledge processes and the knowledge organisation. A possible distinction of maturity levels is defined by the KMMM® (Knowledge Management Maturity Model) [KM08], which was developed within SIEMENS and is a methodology for systematically analysing, measuring and developing knowledge management. The model was developed on the basis of the CMMI® maturity model [CM08] and consists of three components: analysis model, development model and auditing process. The development model consists of five maturity levels for knowledge management. The five maturity levels are organized on top of each other and defined as follows:

(1) **Initial** –Knowledge management is as a whole not organized in a structured way.

(2) **Repeatable** – Pilot projects and single, isolated activities are performed and labelled with "knowledge management".

(3) **Defined** – At this level stable and "practiced" activities exist which have proven to be effective in the organisation.

(4) **Managed** – Knowledge use is organisation-wide integrated into business activities. The success of knowledge management is furthermore systematically measured.

(5) **Optimizing** – A stable and robust continuous improvement plan for knowledge management is implemented.

2.4 Information Availability

The dimension of Information Availability comprises five levels. Each level builds upon the previous one.

(1) **Explicit documentation**: Often new knowledge, e.g. gathered through task execution or learned in a meeting, is kept in mind but not made explicit. Nonaka and Takeuchi introduced the process of externalization, making tacit knowledge explicit [NT05]. That can be done in any manner (e.g. unstructured text, video, audio).

(2) **Transparency**: –To reach the next level it has to be made transparent where the knowledge is stored. Transparency is given when the storage place of all business relevant information is made explicit and well known. As Bock states: "… the volume of information requiring electronic storage is growing rapidly-- upwards of 50 percent per year in many organisations. They realize that more than 80 percent of this new information is unstructured content and that more than 95 percent of this unstructured content is unmanaged" [Bo05].

(3) **Accessibility**: To reach the level of accessibility the business relevant information can be accessed directly e.g. via the intranet portal. "The mere existence of knowledge somewhere in the organisation is of little benefit; it becomes a valuable corporate asset only if it is accessible, and its value increases with the level of accessibility" [DP98].

(4) **Integrated Information (unified metadata)** – Even if accessible, information is often distributed in multiple, often heterogeneous information sources. These can be databases, file systems, email, document management systems or the intranet. Their integration requires the definition of a common data model or unified metadata [BM08].

(5) **Automated Metadata Generation** – Generating metadata automatically unburdens the knowledge worker and decreases the failure rate. There already exist commercial tools based on automated classification and knowledge extraction. With semantic techniques (e.g. having domain knowledge represented in an ontology) new approaches are available [SvH01].

2.5 Maturity of Knowledge Organisation

The knowledge organisation is interesting when optimizing the organisation (the conceptual access structure) of knowledge repositories to support easier retrieval, creation and sharing of knowledge for user communities [SIG00]. It is the objective of knowledge organisation to make knowledge intellectually accessible by using a conceptual structure.

Knowledge organisation deals with (1) building and modelling systems of concepts as well as (2) their mapping to subjects of reality. Methods for knowledge organisation can be arranged in a spectrum with increased semantics:

(1) **Keywords** – On the lowest level there is a controlled vocabulary of keywords that can be assigned to an information asset.

(2) **Categories** – On the next level the knowledge organisation is a flat classification that consists of a set of categories.

(3) **Taxonomy** – A taxonomy is a hierarchical classification system, in which the categories are organised in form of a hierarchy. Thus, a taxonomy structures the data and gives it a simple semantics (cf. [DOS03, p. 146].

(4) **Thesaurus** – A thesaurus extends the semantics of a taxonomy by a predefined set of additional non-hierarchical relationships. In particular these are the synonymy and the related term relationship.

(5) **Ontology** – An ontology further extends the semantics expressiveness by allowing defining concepts and instances as well as any kind relationship between concepts and instances. Daconta et al. divide the ontology level into an ontology spectrum further distinguishing between conceptual model and local domain theory [DOS03].

2.6 Information Management

The dimension of information management considers the structure, security, redundancy, integrity on conflict resolving of information and classifies five constructive levels.

(1) **Structure** – An organisation can be situated on this level if a defined structure for managing information exists, supported by information systems. The activity group "Management of Information Systems" in the framework of [Kr00] describes the general activities which have to be performed.

(2) **Information security** – Based on structured information, data has to be secured against unwanted manipulation. The key issues of information security as defined in the ISO 27001 Information Security standard[3], referenced in different CobiT[4] processes and used by [ISA05] are confidentiality, integrity and availability of information.

(3) **Controlled redundancy** – An advantage of controlled redundancy is increased availability of data and more efficient read access to data, mentioned in the approaches of [To93] and [He02].

(4) **Integrity constraints** – Integrity handles the validity, but also the correctness and completeness of data, as mentioned in [Be96]. During all of these phases, integrity must be considered by implementing appropriate constrains.

(5) **Conflict solving** and continuous proactive development – This last level can be regarded as an iterative process which continuously improves the information management by adapting to the changing environment and be improved with proactive activities. Additionally it can contain rules to suggest how to deal with constraint violations.

[3] http://www.27001-online.com/
[4] http://www.itgi.org/

2.7 Conciseness of Knowledge (Quality of Content)

Another dimension for measuring the maturity of knowledge is the conciseness of knowledge. Here the quality of content and an adequate representation are investigated. A valuable source which is appropriate for our purpose is the list of criteria for measuring the information quality given by the DGIQ[5]. Our approach was to select the following criteria in order to assess the quality of content:

- Appropriate Amount: The amount of information satisfies the predefined requirements.
- Believability: validated information sources
- Completeness: Information is complete for adequately performing a process step
- Concise representation: The relevant information is provided in an adequate and easy-to-handle format.
- Consistent representation: The same information is always presented in the same way.
- Ease of manipulation: The effort for changing and adapting information is manageable.
- Unambiguous Interpretability: There is a clear interpretation what to do for the information provided.
- Objectivity: Information is value-free and based on facts.
- Reputation of Source: The source of information and the processing system are highly reliable.
- Timeliness: The information provided is up-to-date.
- Understandability: Information is easy to understand by the targeted audience.

Each criterion can be assessed on a discrete scale between 1 and 5. The overall conciseness of knowledge can be computed as the (weighted) average value.

3 Knowledge Potentials and Intellectual Capital Statements

There is not a comprehensive picture of intellectual capital statements. Nemetz presented a meta-model that make various approaches comparable [Ne06]. For example, the focus of the "AK Wissensbilanz" approach [ABK04] is on finding and exploiting correlations between organisational goals, business processes, intellectual capital and the business success within a company.

[5] Deutsche Gesellschaft für Informations- und Datenqualität, German association for information and data quality (transl.)

At a first glance our approach for assessing knowledge potentials seems to be similar to existing approaches for developing intellectual capital statements. However, these statements do not give sufficient hints on how to achieve the intellectual capital-related objectives. This is where our approach joins it. It assesses various dimensions of knowledge potentials in order to identify the best approaches to increase the knowledge value.

The knowledge management radar presented in this paper could serve as a completion to the concept of influence factors/indicators in intellectual capital statements in order to get a clearer picture of the maturity of the company at a certain point of time and where and how to improve. Further on, methods to measure intellectual capital mainly focus on the past. But essential for the success of an organisation is also what has to be done to be successful in future. Our approach gives, based on the actual state of an organisation, suggestions how it could mature over the next years.

4 Conclusion and open issues

The framework for assessing the potentials of an enterprise to mature knowledge considers all relevant multiple dimensions that can influence the selection of methods and tools for knowledge management. As far as possible, for the different dimensions we built on maturity models that already exist. The framework is complementary to intellectual capital statement approaches by giving support for the implementation of projects to achieve development goals.

The different dimensions of the framework are not independent from each other. It will be an objective of future research to make theses dependencies explicit and to define a clear set of indicators for each level of each dimension. This is a prerequisite to match the functionality of tools with the situation in an enterprise as assessed by our framework.

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