



Maturity measurement of knowledge-intensive business processes

Maturity
measurement

377

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Abstract

Purpose – The methods of quality management, business process management and knowledge management have until now been exploited by science and the industry separately. An integration of these disciplines could unlock the potential of a solid structure to measure and gradually improve knowledge transfer processes. This paper aims to address this issue.

Design/methodology/approach – A maturity model was developed for SMEs to measure and assess the quality of their business processes. This enabled the companies to determine their existing status and to take the necessary actions for the competence development of their business processes, which should contribute to the attainment of their knowledge management goals.

Research limitations/implications – This paper introduces a maturity model for knowledge-intensive business processes that enables companies to determine their processes' actual state and take the corresponding actions for their business processes improvement, in which special attention is being given to small and medium-sized enterprises (SMEs).

Originality/value – The paper proposes an SME-specified maturity model for knowledge-intensive business processes. Its assessment procedure is developed based on literature researches and investigation of real processes of two industrial SMEs. This maturity model has advantages over other existing models since it accounts for the needs of SMEs by incorporating the company preference over the measured areas.

Keywords Quality process, Knowledge management, Continuous improvement, Knowledge intensive business processes, Maturity model

Paper type Research paper

1. Introduction

Knowledge is built on information and its interpretation. Knowledge is, however, more than just processing information. Polanyi first made this differentiation clear by stating that “we can know more than we can tell” (Polanyi, 1958). Knowledge that is made up of a person’s experiences, interpretations, cognitions, previous knowledge and values is called the tacit knowledge. It is difficult to transfer and always bound to loss of context by the process. Explicit knowledge is not attached to person. It can be found in any written form, presentations and other information media (Lehner, 2000). Both knowledge sorts also commute. Their transformations are comprised in Nonaka and Takeuchi’s knowledge conversions (Nonaka and Takeuchi, 1995):



- *Internalization* marks the alteration of explicit knowledge into tacit knowledge. Reading a document and listening to lectures are examples of internalization activities.
- *Externalization* happens when tacit knowledge becomes explicit knowledge. Writing down one's thought or documenting a meeting protocol belongs to this conversion.
- *Socialization* occurs when tacit knowledge becomes another person's tacit knowledge. Observing an expert during work practice or exchange of news during coffee break is a form of socialization.
- *Combination* takes place when explicit knowledge is used to generate another explicit knowledge. Deleting, sorting, archiving, augmenting or grouping information to give it a new context is one of this conversion's activities.

Knowledge-intensive business processes are characterized by their high amount of exceptions (Remus, 2002). Knowledge bound to these processes' participants is the basic ingredient for the value creation. Activities within these processes cannot be automated or standardized. Classical modeling approaches cannot visualize some activities involving the knowledge acquisition, transmission, dissemination, control and usage within the processes. This leads to companies ignoring the aspects of knowledge in their process improvement planning, or even in their company strategies. To address this problem, many knowledge management methods have been developed. Their application in SME has been relatively low. This is due to the difficult prerequisites and lacking of SME specified structure, which cause disadvantages to SME when compared to large firms. As a result, knowledge related problems that are peculiar to SME such as knowledge monopoly of single experts, the dependency of companies to these experts caused by the monopoly and the often low availability and accessibility of certain knowledge remain unsolved.

SME is in need of a method to assure that their knowledge intensive business processes are in a good shape without being forced to spend a fortune on its application. In this paper we will introduce an SME specified approach that measures the maturity level of knowledge intensive business processes and provides knowledge oriented recommendations for improvement, which is developed within the scope of a project financed by the German Federal Ministry of Economic and Technology. The first section discusses the maturity model and its impact for the implementation of process assessment. Afterwards we describe the development of the proposed maturity model and its success factors as well as its practical implementation.

2. Maturity model

A maturity model can be regarded as a specific competency model that points out different degrees of maturity. Its aim lies on the assessment of in which extent a competence object fulfill the quality requirement criteria defined for a certain competence object class (Ahlemann *et al.*, 2005). The suitability of the maturity level model is constituted by taking into consideration the requirements of objectivity, reliability and validity, whereas consistency, replicability and efficiency are the additional requirements to be consider.

A maturity level assessment is normally done by an assessor that inquires and analyses information about the objects. The qualitative and general requirements

defined for the field of application of the maturity model are arranged and structured sequentially (Jochem, 2006). Beside the classical evaluation by assessors, who are specially licensed for certain maturity models (e.g. EFQM-Assessor), a number of maturity models enables an assessment by the organization itself. These maturity models are based on the principle of self-evaluation and do not represent a traditional audit. Process audits evaluate “whether” the requirements adopted by the organization are met, while process assessments evaluate the “how” (Schmelzer and Sesselmann, 2008). ISO 9004 evaluates the maturity degree of a quality management system for each of its five main sections on a five-point scale (ISO 9004, 2009). The applied performance maturity levels are:

- (1) Simple.
- (2) Proactive (Simple + ...).
- (3) Flexible (Proactive + ...).
- (4) Progressive (Flexible + ...).
- (5) Achieve sustainable success (Progressive + ...).

In the knowledge management domain, different assessment approaches have been proposed (Ehms and Langen, 2000). These approaches mostly focus only on the entire knowledge management activities of an organization. There exists no connection to single business processes. A direct assessment of processes is not possible. Thus, significant process improvement potentials in SME remain untouched since the improvement opportunities in the processes cannot be fully recognized.

Identification of the level of maturity serves as a basis to uncover those potentials in SME. The maturity level has to be identified and the actual situation recognized, only then can SME set a starting point for process optimization and goal achievement. According to Mackie, implementing a sustainable improvement requires people to recognize the opportunities for it (Mackie, 2007). A process assessment also affords an internal benchmarking, which guides employees to adopt preferred similar approaches for appropriate knowledge intensive business processes. The possibility to compare local knowledge intensive business processes with those others on the market allow strengths to be consolidated and weaknesses focused (benchmarking capability).

Process assessment also increases motivation for change. It encourages employees to start implementing improvements activities. By systematically analyzing a process using process assessment it is possible to pinpoint improvements potential. A periodically performed assessment forecasts trend information. The improvement analysis discloses indirect information on which improvements provide an impact and conclusively, the level of such impact.

3. Development of the proposed maturity model

In order to develop the proposed maturity model, we first needed to generate a set of requirement criteria to base the later analysis on. These criteria were defined as a list of success factors and their indicators. The definitions of these criteria were partially found in the literatures describing the important aspects of knowledge-intensive business processes. The practical part was gained through firsthand experience with industrial partners from the fields of customer relationship and product development. In this case, we used both the modeling languages eEPC (extended Event-driven

Process Chain) for the integration of the process flows and KMDL (Knowledge Modeling and Description Language) for the visualization and analysis of knowledge activities within the processes. Figure 1 shows an exemplary activity view of the sub-process feasibility analysis. The participants come to a decision to implement after understanding the requirement specification as well as considering the freedom to operate and implementation cost. The technical feasibility, legal framework as well as profitability check serve as the requirements to be fulfilled, in which existing key market is the concrete application.

These criteria were shown to and evaluated by an interdisciplinary working group from the industry regarding the strategic importance as well as need for action. Some of them were omitted due to the low rating given by the working group.

Based on the resulting consent we were able to categorize these criteria in qualifiers, project success factor and critical success factor. These factors serve as basis for the later development of the assessment model and the user-oriented reference process model. A reference process model recommends the good and best practices of the analyzed processes regarding their maturity level and suggests relevant improvement measures. We also identified measurable indicators of each of the success factors in order to determine the maturity level and capture the specification of the success factors for the future application of the maturity model. An excerpt of the indicators is described in the following section.

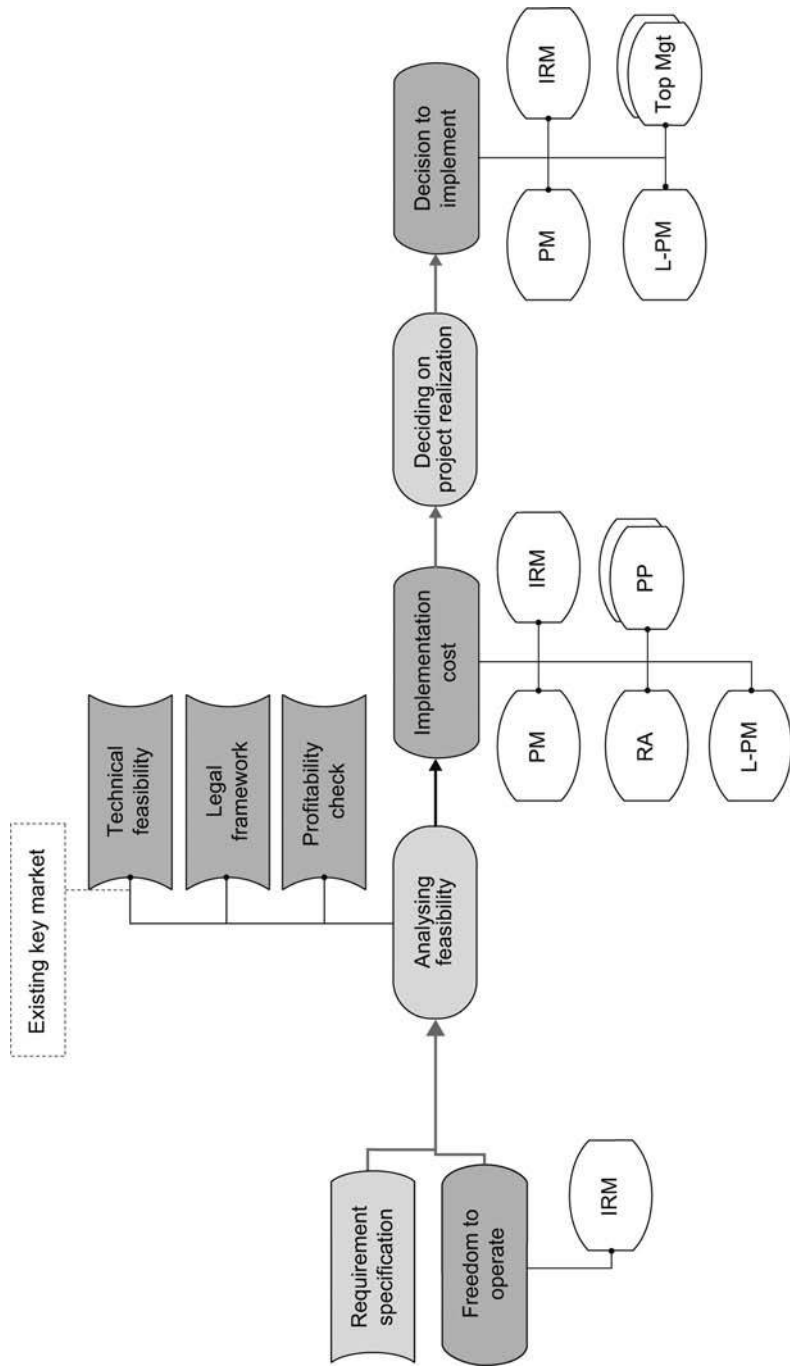
3.1 Knowledge-oriented success factors and their indicators

The proposed maturity model categorizes its indicators into seven key process areas (KPA), most of which are derived the EFQM model. These are leadership, politic and strategies, partnership and resources, process design, knowledge transfer and design, employees, information system, and two process-specific areas (Figure 2). Each KPA is assigned several success factors consisting of knowledge, process and quality oriented indicators. The process specific KPA has its own success factors and can be expanded at will.

The knowledge-oriented success factors represent the assignments of knowledge management as suggested by Gronau in his Potsdam Knowledge Management Model (Gronau, 2009). He lists out 11 assignments that should be performed when managing knowledge. In our maturity model, these assignments are partially adjusted based on the point of views of each KPA and their realizations described according to the related maturity level. The levels of maturity used in the proposed model are derived from the classical CMM-Model, namely initial, repeated, defined, managed and optimized.

Knowledge-related success factors are, for example:

- Securing collective knowledge usage: a company should ensure the willingness of its employees to use and commonly share the available individual and organizational knowledge. This can be done by encourage the knowledge diffusion by controlling the dissemination (direct influence) or by a self organized dissemination through the employees themselves. Professional trainings can be offered as a push mechanism for controlled knowledge dissemination. The company can support self-organized knowledge dissemination by providing a suitable infrastructure that enables access for information and communication channels, like providing newspaper subscriptions (pull mechanism).



Notes: L-PM: Chief of Product Managers; PM: Product Manager; IRM: Innovation Research Manager; RA: Regulatory Affairs; PP: Production Planning

Figure 1. KMDL activity view (excerpt)

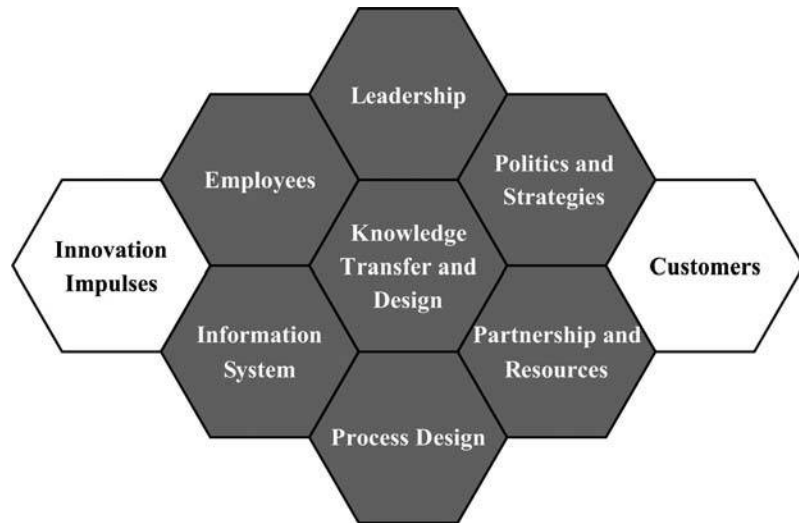


Figure 2.
Process areas

- Knowledge and information storage and maintenance: a structured and systematic maintenance and supply of knowledge is decisive to preserve knowledge. The sustainability of knowledge should be secured by assuring its reusability, not only within a process but also between processes and process instances. However, the storage alone is not enough. Knowledge needs to be regenerated, exchanged and deleted every period of time in order to avoid redundancies and duplication of works. Knowledge that is no longer up to date should be refreshed or renewed. Irrelevant knowledge should be archived or deleted when possible.

Based on the success factors we generated a questionnaire to validate the factors' acceptance level. The maturity model is derived from existing established approaches and distinguishes five different levels:

- (1) *Level 1.* Initial: knowledge intensive process with a non-formal/spontaneous character regarding the process design and handling of knowledge.
- (2) *Level 2.* Repeated: proactive knowledge intensive process with personnel related/non-formal character regarding the process design and the handling of knowledge (process participants are aware of the use of knowledge, individual planning of routine operations).
- (3) *Level 3.* Defined: established knowledge intensive process with a formal character (defined process knowledge (input and output) with clear assignment, defined criteria for quality-oriented process design and performance).
- (4) *Level 4.* Managed: controlled knowledge intensive process with a formalized and proved character (controlled handling of knowledge in the process (continuous), controlled criteria for quality-oriented process design and performance).

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- (5) *Level 5*. Optimized: sustainable knowledge intensive process (optimized and comprehensive handling of knowledge (continuous, up to date, holistic); optimized and quality-oriented process design with continuous improvement).

The result of the maturity level determination enables SME to derive improvement actions for skills development in relation to the handling of knowledge and the design of quality-oriented processes.

3.2 Maturity assessment

One of the aims of the project is to enable SME to self assess their own knowledge intensive business processes. Process participants of the SME can evaluate many different statements based on the real state of the process using a defined scale (fulfilled, partially fulfilled, mostly fulfilled and completely fulfilled). This way, the attainment degree and the remaining answers provide the components for the determination of the process quality. The statements are categorized into each KPA and are based on the success factors described in the previous section.

In addition, the SME are also inquired to provide the aspired capability level as well as the improvement measures they think are adequate and affordable to apply. Each SME determine their own aspired capability level as how they see fit, taking into account the company strategies, aim, vision and mission. The deviation between the two evaluation results shows the company specific need for action that should be fulfilled in order to reach the aspired capability level. This outcome holds in turn for each KPA. The maturity level of the examined knowledge intensive business process is assigned to the KPA. In terms of the classical continuous improvement process (PDCA), regular reviews regarding the affectivity of the implementation of the improvement measures should take place periodically.

The following iterative phases show the practice of the proposed maturity model:

- *Self-assessment*. Process participants analyze a set of defined statements and expose their estimation accordingly. There are four alternative answers, namely does not apply (0-15 percent), partially applies (16-50 percent), mostly applies (51-85 percent) and completely applies (86-100 percent) (Figure 3). This step results in a review of the current state of the process as well as the aspired capability level of each KPA. The need of action is derived from the deviation between actual and aspired states.
- *Identification of measures to improve*. During the discussion in the course of analysing the statement catalogue possible improvements, the corresponding responsibilities and deadlines of the measures are documented.
- *Implementation of the identified improvement actions*. The identified improvements are implemented and appropriate changes are made in the process. After this phase takes place, a periodical self assessment (Phase 1) should be performed in order for the process to conform to the continuous process improvement concept (Figure 4).

3.3 Benefit potentials

The use of maturity models enables enterprises to get an understanding about the processes and their management within different business areas. This shows the potential to arrange the management actions, so that an effective and reasonable

		Not true 0-15%	Partially 16-50%	Mostly 51-85%	Completely 86-100%	
Knowledge Transfer and Design	Knowledge Acquisition	KT.i.4. Process participants recognize their lack of knowledge required to accomplish their tasks			X	Improvement action: - not needed
		Target/Actual			X	
	KT.i.5. Process participants cover their lack of knowledge intuitively and sporadically	Target/Actual			X	Improvement action: - not needed
		Target/Actual			X	
KT.r.5. Process participants are aware of the importance of a sustainable solution for covering their lack of knowledge	Target/Actual			X	Improvement action: - Appraisal interviews (responsible: Mr Maier) (completion date: 5/10/10)	
	Target/Actual			X		
KT.r.6. Each process participant pursues their lack of knowledge individually and irregularly	Target/Actual			X	Improvement action: - not needed	
	Target/Actual			X		

Note: KPA: Knowledge Transfer and Design

Figure 3. Extract from the used questionnaire (KPA: knowledge transfer and design)

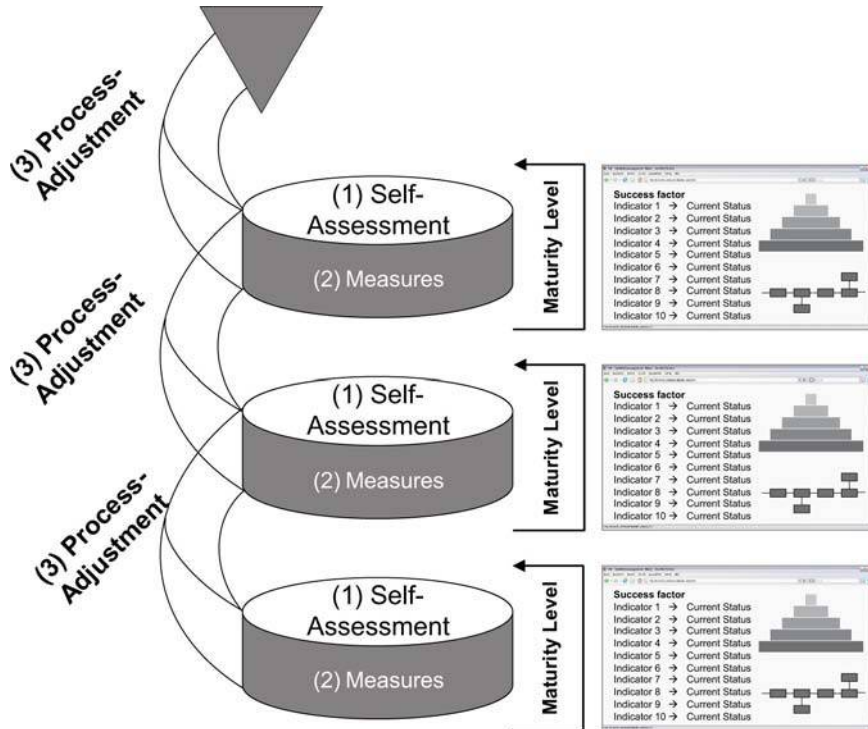


Figure 4. Practice of the proposed maturity model

realization is succeeded. Furthermore, purposeful potentials for improvements are shown, in order to reach the next higher maturity level (Cooke-Davies, 2007). The knowledge and skills gained in the assessment are used to ensure the process quality and/or to increase it incrementally. Through the assessment it is possible to make strengths and weaknesses visible. This is also regarded as an advantage of maturity models, such as the possibility to develop management skills effectively.

If the organization has reached the stage of a consistent and systematic process assessment, then it is possible make intra-industry as well as cross-industry comparisons (Jugdev and Thomas, 2002). This can contribute towards increasing the motivation of the persons involved and supporting the specification of the range of tasks of the task managers. The generation, transfer and storage of knowledge of the employees can be managed in more structured and targeted way for the purpose of the strategic direction (Daniel, 2008).

Furthermore, also critical information with regard to the own competitive position can be provided by a comparison in order to contribute to an improvement and/or maintaining of this competitive position. Moreover, the intra-industry and cross-industry comparisons in the maturity model are the basis for a simplified selection of suppliers by demanding the existence of a defined maturity level. Thus, the attainment of a higher maturity level is not to be considered only as an end in itself, but also as support for a systematic target achievement (Ibbs *et al.*, 2007). The use of maturity models offer the customers the advantage, that weak points and inappropriate developments can be reduced significantly. Hereby new potentials arise in the area of customer oriented processes, particularly the customer loyalty as well as the acquisition of new and follow-up transactions.

Improvements in the two desired and knowledge intensive business processes contribute towards enhancing the innovation capacity of enterprises. This will especially increase the pace of realization of innovations. The reduced time to market of new products or service will boost competitiveness. A holistic approach towards combining business process, knowledge and quality management will create a great synergy for the assessment, evaluation and development of the processes with minimum efforts. The intellectual resources, particularly in the form of employees possessing, assimilating and documenting the process knowledge, are more focused and organized. This results in a better control of the strategic direction of the organization. Moreover, the initial hurdle in adopting such self-assessment method and to develop project tools through this independent approach in terms of costs and resource commitment is far less than when hiring an external consultant.

4. Summary and future prospects

In this paper we propose an SME specified maturity model for knowledge intensive business processes. Its assessment procedure is developed based on literature researches and investigation of real processes of two industrial SME. This maturity model has advantages over other existing models since it accounts for the needs of SME by incorporating the company preference over the measured areas. It also examines the actual state of implementation of knowledge management tasks within the process as well as in the whole company, rather than whether or not some certain knowledge management activities are being carried. Moreover, the calculation of

maturity provides a basis for a systematic identification of efficiency potentials with a subsequent development and evaluation of alternatives and measures.

The next step would be the implementation of a web-based assessment tool, which should enable SME to self-assess their business processes cost effectively. Currently we are developing the technical and usability concepts of the tool. After this task is done, the indicators characterizing each maturity levels are positioned into the tool and a pre-test by the working group will be performed.

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