

EVALUATION OF KNOWLEDGE MANAGEMENT IMPLEMENTATION

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The use of knowledge management tools is growing. With each implementation, the effectiveness of the implementation also needs to be evaluated. This article presents a method for evaluating this efficiency, an outline of its creation and an example of its use in an industrial enterprise.

KEYWORDS

knowledge management, maturity model, methodology of maturity model, information and communication applications, levels of maturity model, knowledge strategy, business strategy

1. INTRODUCTION

Knowledge work changes and matures over the course of an enterprise's development. Several models of the evolution of knowledge management (KM) in an organisation are known from the literature. These models differ in their approaches to the problem, but we have not found any model that has been developed specifically for an industrial enterprise. Therefore, in my work, a customized maturity model of KM with this focus was developed and then tested in an enterprise.

The proposed model takes into account a total of 5 stages on the way to a fully functional KM in an enterprise. It takes into account the evolution of knowledge work in the enterprise from the spontaneous creation, transfer and use of knowledge to a state where systematic KM is an integral part of the enterprise's functioning with substantial and lasting benefits for its competitiveness, the continuous improvement of all internal processes and future direction and investment. The level of maturity of KM is assessed in all major areas of the enterprise's operations. Although enterprises differ in their focus, for enterprises of a particular size and organisational classification (SBU – strategic business unit) we consider

the assessment of KM maturity in the following areas (different enterprises may emphasise different areas):

1. Research and development
2. Production
3. Finances
4. Human resources
5. Marketing
6. Trade

Since KM is based on the use and integration of knowledge from exact and non-exact sciences, its direct algorithmization and complex processing by ICT (information and communication technology) is not possible. Therefore, to determine the level of KM in an enterprise from the perspective of a maturity model, the opinions of managers and specialists were obtained using a survey focused on particular factors of KM in a given enterprise. Knowledge work in the enterprise is divided in this article into five levels in terms of KM maturity model - their basic attributes are:

- **Zero level** - ad hoc work with knowledge

- **First level** - software is created to archive and easily find and access knowledge

- **Second level** - software is created to analyse problems and predict the knowledge needed

- **Third level** - sophisticated apparatus for evaluating the costs of KM is created and the knowledge strategy of the enterprise is created

- **Fourth level** - the knowledge strategy is integrated with the business strategy and a learning organization emerges

Based on the evaluation of the responses of managers and specialists, the level of functioning of KM in all the main areas of the enterprise is assessed. A particular enterprise does not necessarily have to go through all the phases of KM development in its evolution - it depends of course on the time of its creation, the duration of its existence and its financial, personnel, technical and other capabilities. When introducing KM, it is advisable to use the services of a proven consulting company that already has the necessary experience in implementing KM in other enterprises.

2. THE KNOWLEDGE MANAGEMENT MATURITY MODEL

2.1 Zero level

At this level of KM no systematic work with knowledge in the enterprise is assumed - knowledge is created spontaneously during daily operations when solving tasks in the course of internal processes and stored in the heads of problem solvers, teams, documents, drawings or analyses (ad hoc work with knowledge). The missing knowledge is usually obtained by contacting one or several experts (trial and error), by solving a specific

problem or by self-study of relevant documents (drawings, analyses, technical reports, etc.). Zero level KM maturity is further characterised by the following attributes:

- No apparatus for storing or retrieving the necessary knowledge
- No comprehensive overview of the current state of knowledge in the enterprise
- No apparatus for assessing the state of existing knowledge or defining the missing knowledge
- No sophisticated plan for acquiring new knowledge

2.2 First level

At this level of KM, databases and repositories for the storage and managed archiving of explicit knowledge in the form of drawings, calculations, analyses or technical reports and the necessary infrastructure and software for their easy retrieval and access are created in the ICT applications of the enterprise. The first maturity level of KM is further characterised by the following attributes:

- Basic classification of existing knowledge emerges (assigned basic attributes defining the meaning, applicability of the knowledge and other necessary attributes)
- Apparatus for retrieving existing knowledge emerges
- Apparatus for evaluating the status of existing knowledge is created

2.3 Second level

At this level of KM, problem analysis software is created in ICT applications to signal what knowledge is insufficient in the enterprise and to predict what new knowledge will be needed in the future for its sustainable development (linking marketing and development systems). The second level of maturity of KM is further characterized by the following attributes:

- Knowledge resources and knowledge processes are identified
- Knowledge work (or knowledge archiving) is automated
- Apparatus for evaluating the status of existing knowledge and defining the necessary further development of existing knowledge is refined.

2.4 Third level

At this level, knowledge and business processes are integrated and a sophisticated process model and apparatus for continuous evaluation of the level of KM is created. The information and knowledge system becomes a daily assistant at work (employees are not overwhelmed with knowledge they do not need, but can easily find the necessary knowledge or contact its owner). The third level of KM maturity is further characterised by the following attributes:

- Apparatus emerges for tracking knowledge costs and knowledge processes (creation, validation, sharing, use, acquisition from outside the enterprise)

- Sophisticated processes emerge to acquire or improve specific knowledge, including the prediction of resource requirements and automatic tracking of these processes
- The enterprise establishes a system for the institutionalisation of current valid explicit knowledge
- A knowledge strategy emerges as a tool to use the knowledge potential of the enterprise for its survival and further development (including metrics and indicators for its execution and evaluation) supporting the business strategy

Pressure from the management is still required to motivate employees to continuously innovate in their daily work and share their knowledge.

2.5 Fourth level

At this level, the enterprise acquires the basic characteristics of a learning organization (continuous improvement of its work in terms of innovation and customer success in its business is in the minds of the employees and does not have to be enforced by the management). The metrics for evaluating knowledge and business strategy are linked, and the knowledge strategy becomes a core supporting document for the business strategy. The fourth level of KM maturity is characterised by continuous improvement of core and supporting knowledge-based business processes towards continuous growth of competitive advantages and has the following attributes:

- The information and knowledge system takes on a complex sophisticated form to enable regular validation of the enterprise's knowledge base on the way to the planned state (as the enterprise's knowledge strategy is executed), including cost tracking and risk management
- Elements of artificial intelligence are applied - systems for managerial decision making, systems for data mining and knowledge extraction, systems for predicting technology development or expert systems
- The enterprise systematically institutionalizes the current valid explicit knowledge - when the knowledge is updated, all documents affected by the knowledge are revised in a controlled manner (so that only the latest versions are available) and the necessary staff are informed of the change via the intranet. In this way, the most up-to-date state of the knowledge is available to innovators when innovating products and services.

An integral part of the development of KM in the enterprise is the appropriate adaptation of the enterprise's organisational structure and business processes (core and supporting) to the current development of the business strategy and the knowledge

strategy associated with it. Figure 1 shows a comprehensive block diagram of the evolution of the maturity model in the enterprise.

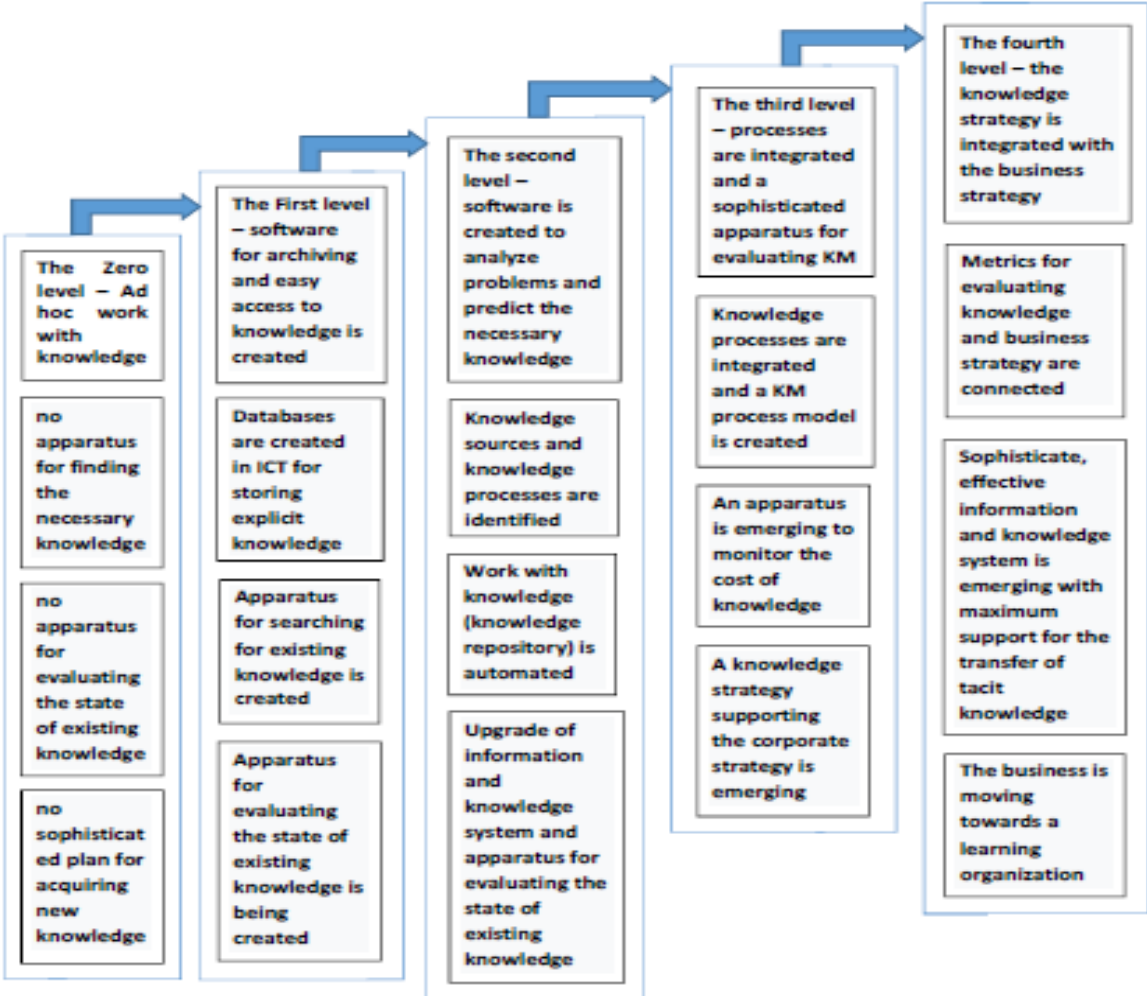


Figure 1: Maturity model of knowledge management [1]

3. EVALUATION OF DEPLOYMENT OF THE PROPOSED METHOD

Comprehensive verification of the proposed method in a specific enterprise will require a longer time horizon, however, it is possible to evaluate some partial steps during the development of this work - specifically the fulfilment of knowledge strategy metrics for the first year of its validity and then the evaluation of individual attributes of the state of knowledge in the enterprise (information and knowledge infrastructure and ICT applications, knowledge resources, knowledge processes, corporate processes and corporate culture). The evaluation was carried out using specialised questionnaires for each of the areas listed below and involved both experts in the field and senior corporate managers. The final value for each of the attributes of the state of knowledge in the enterprise was obtained by averaging their ratings.

The main areas of analysis were:

- **Analysis of knowledge and information infrastructure**

In particular, the parameters of the organization and functioning of the created knowledge management system in the enterprise are evaluated commonly with quality and adaptability of existing ICT.

- **Analysis of knowledge resources**

The subject of the evaluation was the quality and reliability of knowledge resources in the enterprise, the ease and efficiency of their use and their security.

- **Analysis of knowledge processes**

This part of the analysis was focused on the sophistication and effectiveness of the knowledge processes in the enterprise as well as on their mutual conditionality and interconnectedness.

- **Analysis of key enterprise processes**

It was also necessary to analyse other essential processes in the enterprise, both from the point of view of their necessity and effectiveness, and also in terms of their role in the overall performance of the enterprise.

- **Analysis of enterprise culture in terms of knowledge**

This analysis comprehensively tests the general conditions of internal cooperation that are created in the enterprise both for its current functioning and especially for the possibility of its further development.

- **Summarizing the state of knowledge**

This is the final part of the analysis and, in addition to the overall mathematical evaluation of the level of the

enterprise in terms of the functioning of its knowledge management system, it is also intended to provide basic time and content impulses for further development of this subsystem of enterprise management. It also considers its relation to other essential subsystems of the enterprise management system such as innovation management, technical and business development, and especially in relation to the subsystem of strategic management of the enterprise.

These analyses and evaluations are naturally followed by activities, plans and programmes defined in the knowledge strategy using the proposed metrics and indicators. The gradual growth of the enterprise's knowledge base takes place in parallel with the implementation of the business strategy, or the functional business strategies. The integration of the implementation of the business and knowledge strategy is ensured by aligning the indicators and metrics for the implementation of both strategies. The proposed method will be continuously monitored over a five-year period. After that, it will be possible to comprehensively evaluate its functioning.

4. EVALUATION OF THE ENTERPRISE IN TERMS OF MATURITY MODEL OF KNOWLEDGE MANAGEMENT

4.1 Evaluation of the level of knowledge management in the enterprise

Another sub-objective was to examine the current level of KM in selected enterprise in terms of the maturity model defined in chapter 2. Six key areas of the operation of the enterprise (as given in the Introduction) were identified, and 10 targeted questions were defined for each of these areas focusing on the level of a specific factor of KM in the enterprise. One manager and one specialist for each of the above areas were asked to provide answers. In total, 120 responses were obtained in this way (for a larger enterprise, of course, a larger number of managers and specialists could be approached). A five-point scale (0 - 4) was constructed to evaluate the responses, where the quality of the KM factor in a given question increases with increasing number - see Table 1.

Evaluation	Evaluation of the KM factor from the point of view of maturity model
0	Not functioning
1	imperfectly functioning without a concrete plan for improvement
2	imperfectly functioning with a concrete plan for improvement

3	imperfectly functioning with already partially implemented concrete plan for improvement
4	Perfectly functioning

Table 1: Levels of evaluation of the given KM factors in the enterprise [1]

KM factors, significantly influencing and at the same time characterizing the business strategy, are such factors that have a decisive influence on the competitiveness of the enterprise and its further development as well as on its current performance. These factors are not universal, but are specific to the enterprise.

For investigated industrial enterprise acting in the power energy sector the following KM factors were selected and applied to the product:

- thermodynamic efficiency
- ability of quick load changes and quick start up
- long term reliability
- speed of design, manufacturing and assembly

The resulting value for each KM factor was created by averaging the responses of the managers and specialists.

The following breakdown was used for a final evaluation of the current level of KM in the examined areas of the enterprise's operation - see Table 2.

Final index	Comprehensive assessment of KM (maturity model)
0 – 1.00	Zero level KM
1.01 - 2	First level KM
2.01 - 3	Second level KM
3.01 - 4	Third level KM
4.01 - 5	Fourth level KM

Table 2: Levels of comprehensive evaluation of KM in the enterprise [1]

4.2 Definition of targeted questions

The six key areas of the operation mentioned in chapter 1 were considered for investigated industrial enterprise and selected questions are as follows:

Question 1: Are knowledge resources and knowledge processes clearly identified, including their link to company processes?

Question 2: Is the classification of existing knowledge clearly defined (basic attributes defining the meaning and applicability of the knowledge)?

Question 3: Is there a properly functioning system for storing and retrieving the necessary knowledge, including finding the appropriate expert and securing key knowledge against theft (cyber security)?

Question 4: Is the process for assessing the current state of knowledge (benchmarking competitors and business partners) working properly?

Question 5: Is the process for predicting the future state of knowledge defined and the ways to acquire this knowledge, including the definition of the resources needed, working properly?

Question 6: Is the process for institutionalising the current state of knowledge working properly and effectively?

Question 7: Is the knowledge strategy of the enterprise clearly defined and linked to the business strategy?

Question 8: Does knowledge sharing and employee initiative to solve enterprise problems work automatically or does it have to be enforced by management?

Question 9: Does KM sufficiently contribute to the functioning and interconnection of business processes and to the growth of the competitive advantage of the enterprise?

Question 10: Does tracking KM costs work properly?

4.3 Analysis of answers

A summary table of the enterprise's KM level in individual areas (Table 3) and a radar diagram (Figure 2) were compiled from the average ratings of the answers provided by the specialists and managers to the questions defined in the chapter 4.2.

Area	KM level	Maturity of the KM model
1. Research development	3.20	Third level KM
2. Production	2.45	Second level KM
3. Finances	2.10	Second level KM
4. Human resources	2.55	Second level KM
5. Marketing	1.45	First level KM
6. Trade	2.15	Second level KM
Average	2.32	Second level KM

Table 3: The level of KM from the point of view of maturity of the model in the enterprise [1]

The results can then be displayed both in detail (i.e. researched areas) and in the form of an overall evaluation of the implementation of the enterprise's knowledge management system, which can, for example, take the following form (Figure 2):

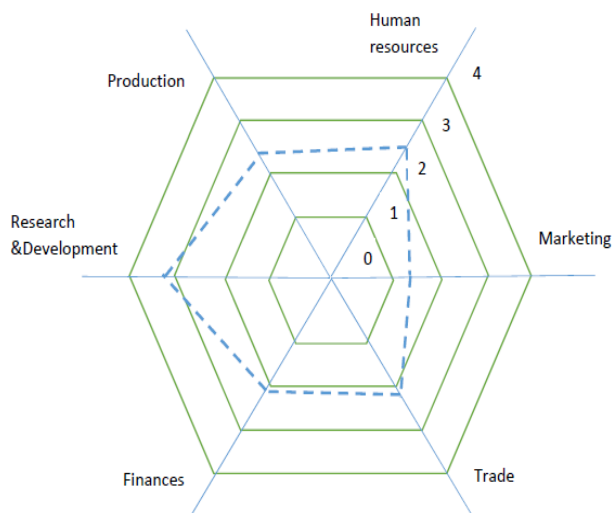


Figure 2: The level of KM from the point of view of maturity model in the selected enterprise [1]

None of the managers or specialists rated any KM factors with grades 0 or 4. The best evaluated is the functioning of KM in the area of research and development where the third level of KM came out from the maturity model.

Human resources, finances, trade and production achieved the second level of KM in the maturity model.

The worst-rated area was marketing, where the first level of KM emerged from the maturity model. This indicates insufficiently developed relationships with important customers and insufficient knowledge of their problems and future intentions (this is especially true for new customers in new market segments where there has not yet been enough time to sufficiently establish these relationships and trust in the enterprise). The overall average evaluation of the state of KM in the enterprise therefore falls into level 2 of the maturity model.

5. CONCLUSION

The paper presents a proposal and methodology for creating a knowledge model of an enterprise and testing it in the enterprise. It is not only a demonstration of a certain type of approach to solving knowledge management problems, but its implementation also showed possible directions and tasks for its further development, which will be published after completing and retesting them in other enterprises.

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