A hybrid method to develop a knowledge management system

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Abstract—The question is the understandability and usability of a method to develop a knowledge system. A method could be the most pertinent, but it might not have a guideline to allow its appliance. CICM (Comprehensive Intellectual Capital Model) is an algorithmic guide to develop a knowledge system. To make it more pertinent, we compared it to GERAM (Generalized Enterprise Reference Architecture and Methodology) requirements, knowing that GERAM is an ISO standard (ISO 15704) of engineering of enterprise. We deduced strengths and weaknesses of CICM. We proposed ACICM Model which is an improved CICM Model, contributing to its change, to become closer and for some criteria to go beyond to the requirements of GERAM. ACICM is more convivial and pragmatic, so more chosen by designers of knowledge management systems. Based on weaknesses of the method of performance scorecard SKANDIA, we proposed an adaptation by enrichment of its set of indicators to be more suitable to developing a knowledge management scorecard, to give (ASKANDIA). A hybridization of ACICM, SKANDIA and business intelligence led to propose SKACICM method. We applied SKACICM on a cement company to develop e-knowledge management system ameliorating performance by a rate of 26%.

Keywords—knowledge management; business intelligence; CICM Model; ACICM; SKANDIA; ASKANDIA; SKACICM.

I. INTRODUCTION

The emerging field of knowledge management addresses the broad processes of locating, organizing, transferring and more efficiently using information and expertise within an organization. New market forces and infrastructure changes have prompted an interest in knowledge management.

Knowledge management is the name of a concept in which an enterprise consciously and comprehensively gathers, organizes, shares, and analyzes its knowledge in terms of resources, documents, and people skills. The benefits of knowledge management are focused on improving decision making, reducing cost of employee training, and increasing versatility of the workforce. The aim is to collect explicit and tacit knowledge to develop an e-knowledge management system to ameliorate the performance of manufacturing system. First, a succinct literature review of the most recent works in knowledge management. We tried making an easy usable method (method with clear guidelines) more pertinent. We improved existing methods using proposed matamodels to propose a new method; we used to develop a knowledge management system. Finally, we discussed the contributions of the new system.

II. RECENT WORKS IN KNOWLEDGE MANAGEMENT

The main objective of Mehralian [5] is to develop and prioritize the most important indicators of intellectual capital in knowledge-based industries. The highest ratios are particularly positive work environment, the ratio of investment in R&D (research and development) and the number of R&D projects in the structural capital, while considering the relational capital. In his work, Lin [6] implies that, in addition to the direction of the market using innovative practices, the high-tech industry should focus more on market knowledge and knowledge management to customers. In contrary, we focused on capitalization of existing knowledge in the company especially the externalization of the tacit ones from the minds of company experts to share them and to improve tangible and intangible efficiency of the company. Khalid et al. [12] found that technology reshapes human behavior and it is the key of implementing knowledge management. In our proposed method, cultural change is necessary to ensure the success of implementing knowledge management. CommonKADS is a method we applied in thermal power plant [13] to externalize tacit knowledge, it presented insufficiency in its modeling language and the absence of implementing tool. We applied SKANDIA in cylinder manufacture [14], to develop a dashboard for human resources of cylinder manufacture. The indicators of SKANDIA were insufficient to cover all managerial aspects of the manufacture. Therefore, we adapted SKANDIA, adding a set of important indicators.

III. GERAM (GENERALIZED ENTERPRISE REFERENCE ARCHITECTURE AND METHODOLOGY)

GERAM has been developed by the IFAC/IFIP3 task force [8], formed at the IFAC World Congress in 1990. It is a framework for the unification of various methods of several domains to support enterprise engineering and integration. It comprises methods from industrial engineering, control engineering, and information systems. It represents a framework rather than a modeling method comprising process models and modeling languages. The GERAM components describe requirements concerning
GERA: Generalised Enterprise Reference Architecture

- Human oriented concepts
- Interoperate elements
- Knowledge
- Possessed by human
- Known during development
- Encapsulate models
- Enterprise assets

PEMs: Partial Enterprise Models
- Are referred to literature
- May concern enterprise entities
- May present themselves from various points of view
- Data models
- Process models
- Organization models

EETs: Enterprise Engineering Tools
- Support processes of enterprise engineering methodology
- Supporting enterprise tools
- Should provide for 1 engineering methodology
- Should provide for 2 engineering languages
- Should provide for 3 enterprise models

EEMs: Enterprise Engineering Methodologies
- Describes 4 enterprise modelling concepts
- Creates and uses enterprise models

EMLs: Enterprise Modelling Languages
- Describes 5 enterprise modelling languages
- Improves relationship among modelling concepts

GERAM: Generic Enterprise Reference Architecture Metamodel

Figure 1. Proposed metamodel of requirements and their relationship of GERAM reference
Figure 2. Proposed metamodel of the three stages of CICM model
reference architecture, modeling language, process model, tools, and enterprise models. We proposed an original metamodel (Fig. 1) defining the role and goals of GERAM. A metamodel is the analysis, construction and development of the frames, rules, constraints, models and theories applicable and useful for modeling a predefined class of problems. As its name implies, this concept applies the notions of meta and modeling.

IV. CICM MODEL

The CICM model was developed by Al-Ali [9] to provide a comprehensive framework for the management of intellectual capital regardless of its function in the business cycle, and whether it is a resource, a process or a product. The CICM model is based on the idea that creating value from intellectual capital follows the same business process or cycle like other tangible resources and assets. It provides a framework that enables management to understand the relationship between the various disciplines and approaches that pertain to intellectual capital management, understand the various practices and services that developed under the banner of intellectual capital management and know where each of these practices fit under the three stages (knowledge management, innovation management and intellectual property management). Based on its weaknesses deduced from its comparison to GERAM requirements, we ameliorated it to give ACICM model. To perform this comparison of GERAM and CICM, metamodels are proposed in Fig. 1 and Fig. 2. This comparison consists to check whether CICM model satisfies GERAM requirements

V. AMELIORATION OF CICM MODEL AGAINST GERAM REQUIREMENTS

In Table 1, the ameliorations of CICM model are proposed, based on confrontation of metamodels of GERAM requirements and CICM model. The relation between the metamodels is whether the CICM metamodel is included in the GERAM one.

VI. ADAPTATION OF SKANDIA (ASKANDIA)

Skandia Navigator is an early model to analyze intangible assets, pioneered by Edvinsson [11] at Skandia enterprise. It comprises a holistic view of performance and goal achievement with respect to intangibles. It’s built of 5 focus areas or perspectives, each capturing different areas of interest: financial focus, customer focus, human focus, process focus and renewal and development focus. Fig. 3 shows globally, the adaptation of SKANDIA to be a quantitative method of controlling performance by enrichment of its book performance with new set of performance indicators to be up to date and to be more convivial to world business. In process 2 of SKANDIA, we proposed to use value explorer. For the third stage of intellectual capital management, which is intellectual property stage, we proposed a suitable method; intellectual asset valuation.

VII. HYBRIDIZATION OF ACICM, ASKANDIA AND BUSINESS INTELLIGENCE TO GIVE SKACICM

Fig. 5 shows the principle of the hybridization proposed of two ameliorated methods, ASKANDIA and ACICM, described in the precedent sections, that consists in the use of ACICM to develop the three stages of a system of knowledge management (knowledge management, innovation management and intellectual property management), and performance evaluation using ASKANDIA. A system of business intelligence was integrated to our developed system to allow to the company to be all the time competitive and resistant to environment change. Fig. 4, from the left to the right, explains the processes and their steps in the knowledge management.
Figure 4. SKACICM kinetic Metamodel
stage. It’s constituted by seven processes; formulation of knowledge-based vision, cultural audit and transformations to knowledge audit, which an important step is consisting to mapping knowledge resources, mapping internal and external knowledge flows. Next, it consists to find strategies to fill gaps of knowledge, defining communities of practice and best practices. Finally, implementation of the knowledge base on information technology architecture after its design.

VIII. DEVELOPMENT OF KNOWLEDGE MANAGEMENT AND INNOVATION SYSTEM USING THE PROPOSED METHOD; SKACICM

The stages of SKACICM method were applied in cement company SCIMAT to develop a flexible tool to gather, share knowledge between the members of the communities of practice. Fig. 6 is an extract from database scheme; it shows a part of complexity of the structure of information and knowledge needed for the knowledge management.

Figure 6. Extract from database scheme

Five communities of practice were created; maintenance, human resources, SCIMAT community which is the sum of all communities of the company. Two extended communities were created; SCIMAT with its partners, SCIMAT with University. Further, a special community will be created, namely, SCIMAT with its competitors. Difficulties are expected when creating this community because of the nature of the relationship between them, and the conflict of their interests.

Figure 7. Functionalities of developed knowledge management system

Among the functionalities of Knowledge management system (Fig. 7); learning module, where the members of concerned community can consult knowledge books. We proposed knowledge books, in maintenance and human resources, containing the explicit knowledge and the tacit knowledge externalized from experts of the company via brainstorming, brainwritings, questionnaires and interviews.

The module “Electronic Document Management” allows the findings of electronic archived documents, plans; this makes it easy the research of documents without going to document center to retrieve documents wasting in sometimes hours. The module “business intelligence” allows the managements of new events, alerts and surveys keep company up to date. The module “collaboration and innovation” allows a communication, sharing of knowledge and ameliorates the creativity of the members of community. The novelties are proposed by a member of community, reviewed by a panel of experts and published if the new idea is accepted. The published idea should be applied by the other members of community and voted. If the vote gives more than 60% of acceptance, it becomes good practice and if it gives more than 75%, it becomes best practice. Then, we add the practice to the catalog of good and best practices (Fig. 8), and so on. This approach will improve innovation and bring wealth to the company.

Figure 8. Knowledge and innovation management
IX. RETURN OF EXPERIENCE OF DEVELOPPED KNOWLEDGE MANAGEMENT SYSTEM

A. Return of experience of professionals, extra studied company SCIMAT

A satisfaction questionnaire was used for the professionals extra the company SCIMAT; 72% of users are satisfied by the functionalities of the developed system. 51% of them consider that it is directly usable by other manufacturing system without arrangements. Modules to improve according to the questionnaire are the skill management and the electronic management of documents.

B. Return of experience at the studied company SCIMAT

At SCIMAT, 83% of users are satisfied by completeness of the developed system. 61% of them consider that it is directly usable by other manufacturing systems without arrangements. Module to improve according to the questionnaire is the security of the system, which we should strengthen. The users of company are more satisfied because of their participation and validation during the development of the system of e-knowledge management.

X. CONCLUSIONS AND LIMITS

The analysis performed in this paper has shown that the metamodels are helpful to designer to refer to need easily. This comes from the readability of the metamodels. Furthermore, the ontologies and glossaries are which we expect to develop for ACICM. It could not satisfy the all requirements of GERAM because ACICM model is an enterprise engineering methodology which is only a component of GERAM and not a complete Enterprise architecture and methodology, certain requirements couldn’t be analyzed in this work. A detailed analysis will be done based on detailed metamodels, in further work. All of these stages processes and steps seem long to apply, in contrary; they are very useful for the understandability of SKACICM.

Contributions of the developed knowledge management system are summarised in:

- It provides the ability to manage its knowledge, ideas and personal skills.
- Stored knowledge is a competitive advantage that improves performance in terms of quality and profitability. It allows company improvement performance of 26.82% after its operationalization.
- A business intelligence system allows internal and external audit to prepare company for contingencies.

For supporting the change, and accompany the developed system, we recommend to the company:

- Integrating the competency-based approach because it encourages the training according the new needs.
- Recruitment of a knowledge engineer.
- Set the new recruits lining with experts.
- Appeal to retirees if necessary to train new employees

- Encourage reflective practitioners because they are experts of the future.

As perspectives of our work, we foresee apply SKACICM in more industrial systems to argue its strengths, and at the studied company we foresee:

- Make the extension to other departments.
- Integrate existing expert systems.
- Improve the generator polls for automatic statistical interpretation.
- Quantification of intellectual capital for concrete gratification.

The developed knowledge management is still to complete by the other communities of the company, create their knowledge books and practices’ catalogs.

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