The representation of Digital Factory Knowledge Entities by the Concept Map

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Abstract –In a world characterized by increasing competitiveness, delivering a good product as soon as possible and increasing complexity of the product, the old method did not satisfy the needs of companies. In this context the Digital Factory (DF) is a solution that has emerged to design and simulate production systems throughout the product design process. In this case, different knowledge from different actors in different departments, are integrating in the Knowledge management system (KMS) named "KSim" and presented in the knowledge pages. With this variety of knowledge entities the actors spent a lot of time in the research of the relevant knowledge and the relationships between all knowledge entities to modify the files related to an error. We propose, in this paper, a module related to the KMS "KSim" able to represent all the knowledge entities used and obtained during the development of digital factory project in the conceptual map named "knowledge map".

Key words: Digital Factory / Knowledge / knowledge management system "KSim" /knowledge map.

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1 Introduction

In the recent decades, a large number of companies sought to value the intangible investment (research and development, training, advertising, organizational methods, etc.) and in particular, their knowledge asset. This asset should be then re-used in different situations in order to reduce the costs and the time of development. Among such knowledge-based situations, Digital Factory (DF) has emerged to design and simulate production systems throughout the product design process. It can be defined as a set of software tools and methodologies allowing the design, simulation, initiation and optimization of production systems [1, 2]. With this definition it is clear that knowledge management is very important in DF. In this context we developed a Knowledge management system (KMS) named "KSim" dedicated to the management of all knowledge entities in the Digital Factory [3]. In KSim, the knowledge is presented in knowledge pages that gather knowledge objects associated with a concept. Then we find in "KSim" a knowledge page of product that gathers all the products of a project, another knowledge page gathers all the parts of this project etc. however the actors found a great difficulty to see all the knowledge entities used and obtained during the Digital Factory project. With the complexity of product and the process of product development the actors spend a lot of time to research the relevant knowledge entities and to research the links between knowledge to correct the errors and modify all the files related to the error. For the purpose of solving all these problems, we develop in this paper a module related to "KSim" able to represent all the knowledge entities of Digital Factory project in the knowledge map to facilitate the understanding and the evolution of the project.

The paper is structured as follows. Section 2 presents a study of the literature: first, we define knowledge entities then we analyse existing methods of knowledge representation. Section 3 describes the proposed framework. Section 4 describes the procedure of knowledge map construction with an example. Finally, Section 5 presents the conclusion.

2 State of the art

2.1 Knowledge Entities

Knowledge can be defined as refined, synthesized, systematized information, or as information associated with a context of use [4, 5]. Merrill proposes a knowledge representation scheme consisting of knowledge components arranged into knowledge objects [6]. The knowledge object or entity is a precise way to describe the subject matter content or knowledge to be taught. It is a framework for identifying necessary knowledge components. It is a way to organize a data base (knowledge base) of content resources (text, audio, video, and graphics) so that a given instructional algorithm (predesigned instructional strategy) can be used to teach a variety of different contents. Knowledge objects should consist of components that are not specific to a particular subject matter domain.

2.2 Knowledge representation method

In the literature, several techniques of knowledge representation have been devised for knowledge based applications in different domain insurance, banking, economic management, Process development Product…Among these methods we can find "Frame" [7], "Knowledge Page" that gathers knowledge entities associated with a concept, "Knowledge map" that a graphical representation of a set of knowledge entities… In this study, we are interested in the knowledge map which it is playing an important role in the KMS [8] to express the knowledge hierarchy and knowledge connection. Many research related to knowledge map have been carried in the recent decades. As an example [9] used a knowledge map to conceptualize the problem effectively and efficiently to gain a full understanding of a problem. [10] proposed a knowledge map for the complex product design and development to improve the utilization efficiency of the knowledge using and shorten the time and effort spent on the Knowledge screening. [11] proposed a knowledge map based on knowledge reuse process and its support to product design. But until now there is no common knowledge map able to represent all the knowledge used and developed during the development of Digital factory project and the link between these knowledge entities. So, we propose, in the next paragraph, to use a KMS named "KSim" [3], which able to manage all the corporate knowledge for the development of digital factory, to present the knowledge map of all knowledge entities used and developed in the digital factory project to facilitate the understanding of the project development process and to reduce the time of research of adequate knowledge entities.

3 Proposition

According to current conceptual model of KSim [3], the knowledge entities are linked. Indeed, the actors need to know and to see the general knowledge and need all the results obtained during this project to accomplish their works. Figure 1 shows the links between knowledge entities. For example the product is composed by several parts that have a materials and files of calculation,

manufacturing and simulation by F.E. For the calculation file, the actor used a technical standard. Furthermore the experts of simulation need the results of product, process and resource to do the simulation…

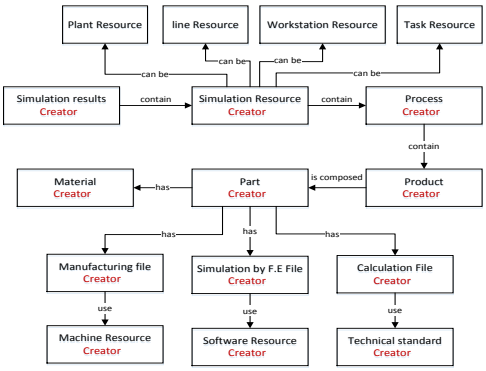

Figure 1. The links between knowledge entities in KSim

To facilitate the understanding and evolution of the digital factory project and to know the relationships between the knowledge entities, we proposed to develop the knowledge map. To build it, we need three layers: graphic layer, description layer, and database layer (figure 2). The graphic layer refers the knowledge nodes and their relationships. The description layer is a link between the graphic layer and database layer. The database layer refers to the storage of all information and knowledge entities inserted in Info Sim [5] and KSim. Knowledge map is made up knowledge nodes and knowledge links:

• Knowledge node represents the name or title of knowledge entity and the name of creator or the person who has inserted this knowledge entity,

• Knowledge link is the line among nodes represents the relationship between the nodes.

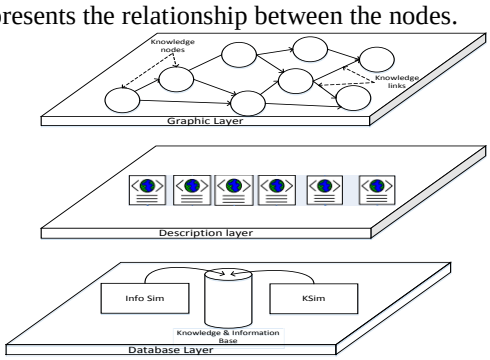

Figure 2. Conceptual layered model of knowledge map

4 The procedure of knowledge map construction

To construct the knowledge map, we must first integrate the general knowledge in KSim and the project information in Info Sim [5] and the relation between the knowledge entities. For example the figure 3 shows the technical standard that is a general knowledge entity used in the project knowledge of calculation. These integrated knowledge entities are stored in the database then presented in XML file that refers the description layer. The XML file is a source for the design of knowledge map. Finally, according to the data presented in figure 4 the knowledge map (figure 5) is made.

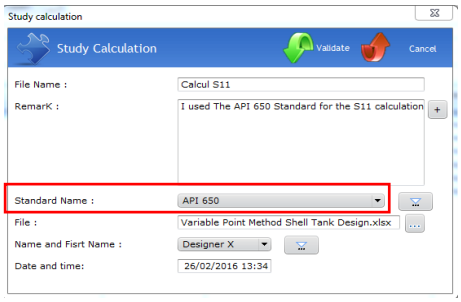

Figure 3. The knowledge description in KSim

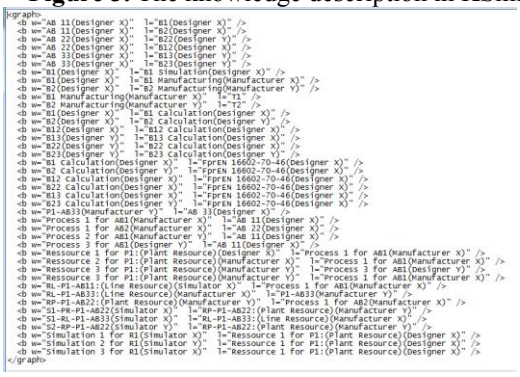

Figure 4. Example of XML file

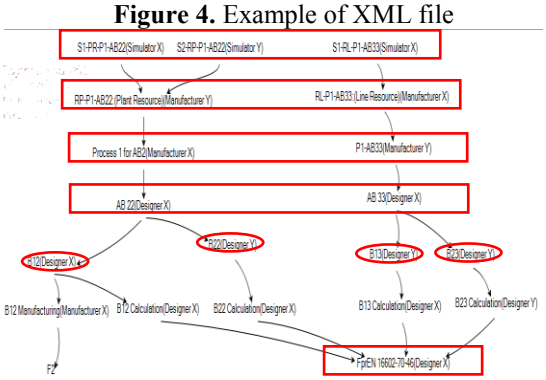

Figure 5. Example of knowledge map

Figure5 presents an example of knowledge map developed in our KMS "KSim" [3]. These figures show all the knowledge entities used and obtained during a project of Digital Factory and the relationships between all knowledge entities. For example in figure 5, we can see the links between simulation and resource, resource and process, process and product, product and part, part and files of calculation, calculation file and standard technical…

5 Conclusion

In this paper, starting from the definition of knowledge entity and the KMS "KSim", we developed a module for the design of knowledge map in "KSim". This module allows the presentation of all knowledge entities used and

obtained during the development of Digital Factory and the relationships between them. The knowledge map helps the actors to understand and see the evolution of project, to know all the actors involved in this project, reduce the research time of relevant knowledge entity, see all the relationships between knowledge entities thus know the errors as soon as possible.

In the future work we will develop more this module to be able to present the characteristics of the links between knowledge (for example is composed, has…). Our KMS "KSim" able to support the integration of all actor viewpoints so we must think to develop a knowledge map able to represent all these viewpoints with their actors.

6 References

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