Research on the Classification and Constitution of Knowledge in the Manufacturing & Machining Process of Flow Industry

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Abstract Considering the balance between integrity and flexibility of knowledge management in manufacturing & machining process of flow industry, knowledge cell could be defined according to different status of on-the-make product. Then, a generalized knowledge constitution model is brought forward with the classification of knowledge into three aspects: knowledge cell, relationship knowledge, and process knowledge.

Keywords Flow industry • Knowledge cell • Knowledge classification • Manufacturing process

1 Introduction

Since the 80th of last century, Knowledge Management, as a concept accompanied by knowledge economy, has been attached much importance and developed a series of tools with the development of communication and computer technology. Being an essential strategic resource of enterprise, knowledge plays more and more important roles in the process of enterprise operation. Based on information technology, Knowledge Management System has been introduced and taken effect in all industries, especially traditional manufacturing industry. However, the application of knowledge management in flow industry is remarkably different from that in traditional manufacturing industry, because of its own characteristics.

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This paper focuses on the manufacturing & machining process of flow industry and discusses about the methods of knowledge classification, and then brings forward the organization and constitution pattern of knowledge, which is expected to make some contribution for the effective knowledge management of enterprise.

2   Knowledge Management and Knowledge Classification

Based on the thoughts of several genres, the concept of knowledge management could be described as follows:

Knowledge management is such a process that community knowledge and skills are grasped and distributed into the most-output points of enterprise. The aim of knowledge management is to make organization members acquire needed information and knowledge rapidly and expediently, that is, to transfer the right knowledge to the right man at the right time in order to make the best decision. Knowledge management should be used to improve innovation skill, response ability, and productivity of individual, section, and organization (Maryam et al. 2001).

Knowledge management emphasizes the integration of knowledge contained in interior &exterior environment of enterprise and the development of self-improvable system, which could offer help for the effective communication, forecasting, and decision-making. The appearance of knowledge base and expert system provides technology support for the realization of knowledge management. Basically speaking, knowledge base system and expert system should include:

- All functions of database, including efficient storage, data sharing, data safety, parallel control, fault recovery, and etc.
- The functions of knowledge storage and management;
- The abilities to deal with knowledge by inference module (the core of knowledge base system) (Wang et al. 2009);
- A rule base and an inference level, except for RDBMS (Related Database Management System)
- The abilities to storage and manage adequate facts and rules (Li et al. 2005);

When transforming domain knowledge into exportable and feasible resource, knowledge classification will be needed to analyze the relationship and structure of different knowledge. Lots of classification methods have been brought forward in literatures. From the macroscopical point of view, knowledge could be divided into interior knowledge, exterior knowledge, knowledge life-circle, tacit knowledge, and explicit knowledge (Nonaka 1994); based on realization pattern, knowledge could be divided into domain knowledge, inference knowledge, and task knowledge (Zhu et al. 2002). The classification of knowledge will decide the integrity and efficiency of knowledge management frame directly. Therefore, effective knowledge classification will not only help enterprise manage its contained knowledge more efficiently, but also improve the flexibility and analysis ability of knowledge base.

3 The Classification and Constitution of Knowledge in the Manufacturing & Machining Process of Flow Industry

Comparing with traditional scattered manufacturing industry, the most remarkable characteristic of flow industry is the difficulty in compartmentalizing Work Cell & Work Center. In scattered manufacturing industry, work center could be defined according to individuals, workstations, or the whole assembly line. Each work center shares independence, stabilization of knowledge structure, and specialization of knowledge. Based on different craftwork process and work center, enterprise could set up and integrate Knowledge Cell to describe the whole manufacturing & machining process and develop knowledge base system.

However, in flow industry, there exist difficulties in compartmentalizing work center because of the continuity of product manufacturing & machining process. To be sure, we could set up knowledge base model based on the whole pipeline, which could make it easier to integrate and maintain knowledge base, while the flexibility and innovation ability would be depressed. Furthermore, this method tends to produce mass of redundancy. Thus, it is important to pursue balance between integrity and flexibility, that is, obtain the needed flexibility and guarantee the system integrity simultaneously. A kind of method will be introduced as follows, which could be used to compartmentalize the manufacturing & machining process of flow industry effectively.

The manufacturing process of flow industry is closely correlative with the characteristics change of product &material. The modification of predefined parameter or material amount would make influence on the chemical or physical characteristics of product and material. Defining knowledge cell according to different status of on-the-make product will be helpful to compartmentalize involved knowledge in manufacturing & machining process effectively, and provide a powerful base for the development of knowledge base system. The description of product status could be realized by clustering method. In traditional scattered manufacturing industry, part or accessory is the basic unit of clustering and clustering is conducted according to the comparability of each part or accessory (Zhang et al. 2013); while in flow industry, considering the continuity of manufacturing process and time dimension, on-the-make product could be divided into several relatively stable statuses according to the change of each parameter and its influence on product. When the manufacturing & machining process is relatively simple, knowledge cell could also be defined by the change of status caused by the increase of raw material or assistant material. The compartmentalization of manufacturing & machining process and knowledge cell shows as Fig. 1.

Knowledge cell compartmentalized in Fig. 1 is not completely independent. The modification of one status or one parameter is probable to induce the change of several statuses or even the whole process, and thereby cause the emergence of new knowledge. Furthermore, this kind of method could not contain all knowledge involved in manufacturing & machining process. Some rules and regulations which
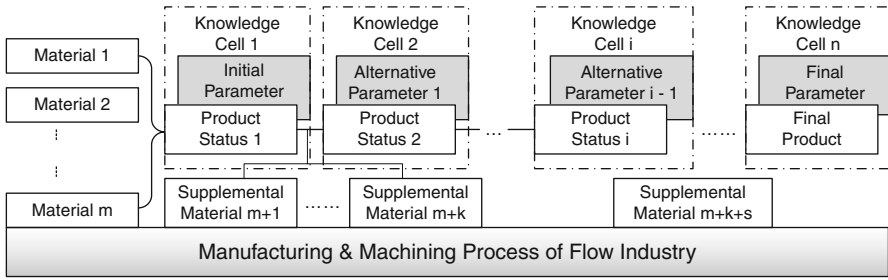
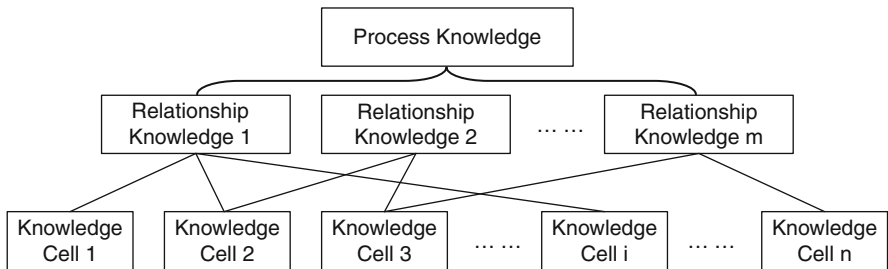**Fig. 1** Knowledge cell compartmentalization of manufacturing & machining process

Fig. 2 Knowledge system of manufacturing & machining process

represent the relationship of each knowledge cell should be extracted and managed independently, such as, which statuses of craftwork would be influenced by the modification of "Product Status i", how many statuses would change if a parameter in process adopts another value, and etc. Such knowledge could be defined as Relationship Knowledge (expressing the relationships between several statuses) and Process Knowledge (about the expression of the whole process).

Thus, Knowledge Cell, Relationship Knowledge, and Process Knowledge constitute knowledge about manufacturing & machining process in knowledge base (Guo et al. 2002; Li et al. 2011). The relationships among them show as Fig. 2.

According to this classification, knowledge in manufacturing & machining process could be decomposed into relatively independent knowledge cell in each level, and the relationship of each knowledge cell is expressed by Relationship Knowledge. When setting up knowledge base, it is important to describe knowledge cell felicitously, that is, transform knowledge into such a language that computer could accept and storage. Documentation description is a widely accepted method, by which every kind of experienced knowledge could be coordinated and new knowledge could be inspired rapidly. However, a powerful searching engine and inference module would be needed to support the description and management of Relationship Knowledge. Extension Theory (Cai et al. 2010) also provides us useful references in this area.

4 Conclusion

Based on the characteristics of manufacturing & machining process of flow industry, this paper analyzes the classification of knowledge cell, and brings forward a constitution pattern of knowledge. Indeed, the effective management and realization of highly-abstract knowledge with the help of advanced technology still attracts lots of attention. And the decomposition and integration of process knowledge and knowledge cell is worth more research in the future.

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