Knowledge-based Manufacturing Enterprise and Enterprise Knowledge Management

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Abstract: Market competition is becoming more intense, more and more enterprises cannot depend on single factor to obtain competitive advantage. Manufacturing enterprise is main body in China social economy, but knowledge capital isn’t regarded enough and enterprise is difficult to survive in intensive market competition. In knowledge economy, knowledge management is becoming an important respect in enterprise management. Firstly, this paper introduced the development and characteristic of modern enterprise, and relevant concepts of knowledge management (KM) are discussed. Then several KM technologies are introduced, which include knowledge sharing and transferring, knowledge storage and knowledge creation etc, and knowledge management system(KMS) framework is given. The Concept of Knowledge-based Manufacturing Enterprise(KBME) is proposed and its key characteristic is to achieve competition advantages by knowledge management and knowledge innovation. Finally, KBME concept is analyzed, and knowledge management and its key technologies in KBME are introduced.

Key words: Knowledge Management; Manufacturing Enterprises; Knowledge-based Manufacturing Enterprise

1 Introduction

Knowledge economy is built on the possession and configuration of intellectual resources and knowledge production, distribution and reuse[1]. Market competition is becoming more intense, more and more enterprises cannot depend on single factor to obtain competitive advantage. Manufacturing industry is main engine of China's economy. Over the past 20 years, Chinese economic growth largely depends on the manufacturing industry, and the scale and level of manufacturing industry has been a symbol of modernization and comprehensive strength.

At present, knowledge economy and knowledge management has become a common concern in economists and management scientists. But as a main part of social economic, manufacturing industry pays little attention to intellectual capital, and it is necessary that knowledge capital management should be regarded by manufacturing enterprise in order to benefit from the potential opportunities and challenges.

2 Modern manufacturing enterprises

For modern manufacturing enterprises, shorter product development cycle and lead-time of new product is the key to win the competition. Enterprise integration becomes tighter and tighter, which not only includes information integration and technology integration, but also implies enterprise management, personnel and environment integration. Under knowledge economy environment, modern manufacturing enterprises are changing from production-based enterprise to knowledge-based enterprise, and the change direction includes intelligent product, and intangible assets, flexible production, and networked manufacturing[2].

For modern manufacturing enterprises, information and knowledge become an important factor in competitiveness. As a whole, China's manufacturing technology is still relatively behindhand in comparison with the developed countries, and the ratio of added value of China's manufacturing enterprise far below the United States, Japan, Germany and other advanced countries. The main reason is that China has lagged industrial technology, high proportion of industrial materials consumption but low ratio of added value[3], so it is necessary to enhance the ity of technological innovation through knowledge management and information management in manufacturing enterprise.

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3 Manufacturing enterprise knowledge management

3.1 Knowledge management

In recent years, as a new concept knowledge management is presented, which it is a cross discipline among management science, social science and information science. Knowledge management is a key management unit and management tools in the era of knowledge economy, and it can improve competitive advantages and help policy makers to make reasonable decisions\(^4\). Due to different professional backgrounds, knowledge management has many interpretation and understanding from different points of view. For manufacturing enterprise, knowledge management can be defined as a process in which enterprise knowledge and skills are acquired and are distributed to anywhere that can achieve maximum benefits. In other words, knowledge management is a series of process of collecting organizing, innovating, diffusing, using and developing enterprise knowledge that enterprise business process depends on\(^5\).

As a new management pattern, knowledge management is developing rapidly, and it is also resource management process and continuous process optimization cycle of enterprise oneself\(^6-7\). Knowledge management is necessary in the whole process of enterprise daily operation. In fact knowledge management is to provide a relevant platform for the exchange and sharing of knowledge to ensure that those who need it most obtain the most appropriate knowledge in the shortest time.

3.2 Knowledge management technology

Knowledge management technology\(KMT\) is computer-based information technology that can help people produce, store, process and transfer knowledge, which is built on data management and information management technology. KMT makes knowledge management personnel and knowledge workers produce, share, and use knowledge easily\(^4-6\). KMT has become an important factor in knowledge management implementation.

(1) Knowledge sharing and transfer technology

Knowledge-sharing and transmission technologies including Web, corporate intranet, and enterprises extranet, distributed systems and so on. Internet transfers and share information with tens of thousands of documents incessantly, and it is the main driving force for the knowledge-based economy era. Intranet refers to the enterprise internal network system that be used to support internal employee to access enterprise knowledge and information using Internet technology in firewall. Based on Intranet, personnel can cooperate and communicate with each other. Extranet can be regarded as an external network system based on Internet technology in order to connect external enterprises and enhance efficiency of information sharing and collaboration.

In addition, there are many other technologies for knowledge sharing and transmission, such as workflow systems. They have different purposes and functions and are the foundation of knowledge management implementation.

(2) Knowledge storage technology

Knowledge storage technologies include data warehouse, document management systems, expert systems and so on. For knowledge discovery, data warehouse is an important storage tool. Document management system stores structured knowledge and transform paper-based documents to electronic documents. Expert systems can store expert knowledge in knowledge base with production rule form, for fear the loss of a valuable knowledge after employee demission.

(3) Knowledge creation technology

Knowledge creation techniques include data mining, model simulation and so on. Data mining is a kind of technology that searches relations and rules implied in enterprise large databases to guide decision-making using statistics, artificial intelligence and other analytical techniques. In addition, there are many other technologies in knowledge creation, such as collaborative filter mechanisms.

3.3 Knowledge management for product life cycle

The ultimate goal of manufacturing enterprise is to create tangible products from sale. Each stage of product life cycle includes many knowledge types. To implement knowledge management, we must classify, abstract, modeling knowledge in life cycle firstly. Since product life cycle involves many knowledge types, knowledge classification should meet the user requirements of searching and using
Product life cycle is the whole process from production to recycle. According to life cycle modelling, we can divide product knowledge into design knowledge, manufacturing knowledge, maintenance knowledge, and recycle knowledge, etc. From the form of knowledge, product knowledge can be divided into four types: document knowledge, data knowledge, program knowledge, and collaborative knowledge. Knowledge organization is to integrate all kinds of product knowledge in order to search and use them. Ontology is an effective way to organize knowledge. Knowledge organization framework is a mechanism that describes the knowledge concepts and knowledge content, and various information objects can be described, connected and organized according to knowledge structure.

3.4 Knowledge management infrastructure

Knowledge management platform is an extensible three-tier structure, which is shown in figure 1. This platform is established using ontology and Internet information exchange technology based on existing information management system. Basic layer includes basic network tool and bottom software components etc. Service layer includes application components, data management, security management, document management and collaboration management services. Among them, business layer provides standardized knowledge components. Data management provides software modules for data exchange. Document management includes version update, version history, process management, approval flow management; Cooperative management includes workflow management, project management, virtual seminar management, mail management and other services. Application layer provides knowledge portal through which user can access enterprise information and applications, and the portal connects search engine closely and provides many classification approaches. Extensible knowledge management system will be knowledge innovation system in manufacturing industry.

4 Knowledge-based manufacturing enterprises(KBME)

4.1 Basic characteristic of KBME

KBME comes into being based on traditional technology-intensive manufacture enterprise, which takes knowledge and human power capital as the strategic resources, and achieves competitive advantage through knowledge innovation. So KBME is dense-knowledge enterprise with realizing knowledge sharing and exerting human’s creation adequately[1].

Generally KBME’s structure is networked which the boundary is relatively fuzzy. Multifarious outsourcing and cooperation have replaced many functions in traditional enterprises, and virtual
production pattern is realized. KBME should be good at gaining, expressing, transferring and using knowledge specially.

Knowledge acquisition is a process that transforms recessive knowledge into dominant knowledge. There are many knowledge acquisition approaches because of different existence format of recessive knowledge, which includes expert knowledge in human brain and relation knowledge in database.

Knowledge representation makes people grasp and use knowledge quickly, and enables the computer to be able to process knowledge effectively.

Knowledge transferring process can happen in enterprise organization interior, between human and computer, among different business process and product, which includes knowledge conversion, sharing and management etc.

The chief goals of knowledge usage are to utilize core knowledge based on accumulated enterprise knowledge base, and improve the ability of knowledge absorption and integration, which makes knowledge become enterprise innovation engine.

4.2 Knowledge Management for KBME

Knowledge management focuses on maintaining enterprise knowledge, and collecting, representing them. Based on open knowledge management infrastructure, a new approach for knowledge sharing is provided and enterprise staff's creativity is inspired, which makes enterprise grow better through improving innovation ability using collective wisdom. Future competitive advantages will lie on knowledge and study ability hold by enterprise in intense competition environment\(^6\). An effective knowledge management framework can provide the appropriate knowledge for individuals and enterprises, so market competition ability is improved. Because a majority of enterprise knowledge rooted in employee is stored in knowledge base, the knowledge loss by reason of employee dimission will be reduced in evidence.

Advanced design technology is inseparable from effective knowledge management. Considering a large number of complex manufacturing and design information, many enterprises have implemented product data management system(PDMS) that is used to manage and control a large number of explicit knowledge produced by CAD/CAPP/CAM tools. PDMS is the core part of knowledge-based design automation systems, and manage all the product knowledge and data in the whole life cycle. Actually PDMS is a knowledge integration platform, which realizes knowledge sharing and provides product data in product development process.

A lot of high technologies, such as NC technology, electromechanical integration technology, and intelligent machine, etc. are used in modern manufacturing enterprises in order to achieve more precise and flexible production. Based on a great deal of enterprise knowledge, computer technology, electronic technology, and network technology are regarded as a tool to achieve advanced production. So enterprise should not only consider knowledge integration and innovation, but also require a large number of knowledge workers to learn and master operation technologies. By studying each other, knowledge worker can present new problem and solve it. Therefore, knowledge management is indispensable during applying advanced technology.

4.3 Key technologies for KBME

Under the environment of knowledge economy, as a rising industry KBME pay more attention to knowledge management with more knowledge requirements. Key technologies for KBME include integrated technology, intelligent technology, network technology, multi-disciplinary and multi-functional integrated product design, manufacturing technology, virtual reality technology, knowledge management technologies\(^1\).

Knowledge management system(KMS) is a software system that manages enterprise knowledge using information technology and management technology, and its aim is to accelerate knowledge flow and sharing among enterprises or its interior departments. Through a combination of e-mail, file transfer and multi-threading bulletin board, basic KMS can be developed, in which basic functions include information search, data mining, and information release.

As KBME’s key factor, intelligent manufacturing requires CAD, CAM and CAE systems solve design problems in given domain with human experience and knowledge, and resolve complex design issues involved multi-domain through collaborative work. To support innovation design for complex
product, collaborative platform can be established[8-9]. Early intelligent system mostly appears in the form of design expert system, but there are many limitations in the size and complexity of design object. Knowledge-based CAD/CAM/CAE will become new intelligent design approach and decision automatization tool, and it is an important means for speeding intelligent manufacturing.

5 Conclusion

Knowledge economy and knowledge management has been an important research topic by economists and management scholars jointly. In knowledge economy, knowledge management is becoming an important respect in manufacturing enterprise management. This paper introduced the development and characteristic of manufacturing enterprise, and the relevant concepts of knowledge management are discussed. Then relevant technologies in KBME are introduced, which include knowledge sharing and transferring, knowledge storage and knowledge creation etc, and knowledge management system framework in KBME is proposed. The key characteristic of KBME is to achieve competition advantages by knowledge management and knowledge innovation. In conclusion, with the development of knowledge economy, knowledge management is becoming more and more important for manufacturing industry. It is worth studying unceasingly how to incorporate knowledge management theory into the applications in manufacturing enterprise.

Acknowledgements

This paper is supported by Natural Science Fund of Hubei Province(Grant No.2005ABA274), Natural Science Fund of South-Central University for Nationalities (Grant No.:YZZ04007).

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