The research of knowledge management for product developing model

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This study proposes to construct a product development model through using knowledge management system. This model aims to help the design engineers and their upstream and downstream partners in the supply chains to develop products synchronously and simultaneously through the computer supported cooperative work (CSCW) tools. The collaborative design in this model consists of three layers: data layer, information layer, and knowledge layer, which separately deals with product data exchange, information sharing and collaborative decision-making in the design process. Based on the principle of product design, the study had integrated the innovation method of theory of invention problem solving (TRIZ) with the methods of knowledge management to develop this collaborative design model. This model includes knowledge management platform and integrating the design notions of innovation, environment protection and manufacturability; it can also serve as a feasible reference for products collaborative design and development process.

Key words: Knowledge management system, collaborative design, computer supported cooperative work.

INTRODUCTION

In dynamic and competitive environment, innovation becomes the main factor for the business to increase value and improve competition ability (Madhavan and Grover, 1998; Subramaniam and Youdt, 2005). Firms with higher creativity and innovative ability will produce the unlimited business opportunities (Montes et al., 2004). Thus, under the growing trend of environmental protection and the environmental law passed by European Union in July 2006, will have tremendous impact on the products manufactured in the future (Curran, 1996). International brands, in meeting with the new demands impose strict rules regarding green design on manufacturers. Therefore, the idea of green design is now a top priority for many products in the market. In various fields, researchers are all contemplating new designs in an effort to create products that meet the new global standard. Firms must have to consider the environmental issues and perpetual innovation simultaneously for solving such problems, although producing eco-innovated products has become the inevitable global trend.

In today's information technology, firms with complete knowledge management system contribute to the overall future development and product's innovation. Knowledge management can improve the stock of knowledge available to the firm and raise the potential for versatility generation and engagement in innovation activities (Nanaka and Takeuchi, 1995; Coombs and Hull, 1998; Scarbrough, 2003; Huang and Li, 2009). Knowledge management is also the main factor for leading and enhancing the firms' innovation performance (Coombs and Hull, 1998; Johannessen, Olesen and Olaisen, 1999; Lin and Li, 2005). Blending green design with creativity will certainly be the mainstream for all products in the future and a topic worth discussing. Creativity is the means of materializing designs, which is also the idea for solving certain issues. Creativity is crucial in product design, and the reason is that a design requires thoughts and implementations; the idea is first mapped and then produced.

In recent years, many advanced countries have listed green design as the number one priority in government
purchase. Thus, the green design found in products can not only increase sales, but are also beneficial to their recycling concerning environmental impacts- including material selection, function, manufacturing process, wrapping, and transportation. Based on the principle of green product design, this study proposed to construct a design model for green product through knowledge management system. This model aims to help the design engineers and their upstream and downstream partners in the green supply chains to develop their products synchronously and simultaneously through the CSCW tools. This model includes knowledge management platform and also integrating the design notions of innovation, environment protection and manufacturability which can serve as a feasible reference for the products collaborative design and development process.

LITERATURE REVIEW

TRIZ theory and green design

TRIZ was a theory developed by Genrich Altshaller in Russia in 1965 (Ashuller, 1996) and was based on the patents. Altshaller also provided a system that was used to analyze and solve problem through inventive principles. Altshaller analyzed thousands of patents and identified the same fundamental problems and found the same fundamental solutions that took place over and over again in technological area. TRIZ was a tool with knowledge and experiences of the world's finest inventive minds, for design engineers to handle these conflict conditions during the innovative design problem solving process (Savransky, 2000).

The main elements of TRIZ were the contradictions, 40 inventive principles, matrix and the rules of evaluation used to solve over 12000 contradictions between pairs of 39 standard engineering parameters. The most important parts of TRIZ was the contradictions, through analyzed large amount of patents' problems and solutions, the ideas were created to assist in solving the problems. In the field of science, TRIZ was an innovation methodology providing a systematic process to define and solve any given problems. It has been observed that many scholars have compiled different methods and techniques that are related to green design. Navinchandra (1991) provided green labeling for Green designs; Rombouts (1998) applied expert knowledge on Green design. Tu (1998) used life cycle assessment (LCA) on product recycling; Freemdiel et al. (2002) listed 23 successful cases of Green design on electrical products. As for innovating designs, scholars in Europe and America have combined conventional design with contemporary creativity. On the subject of the integration of Green design and creativity, theory of invention problem solving (TRIZ) is currently under the spotlight. Jones (2001) applied structural design to Green design; Liu and Chen (2001) combined engineering parameters in TRIZ method with the 7 Eco-Efficiency Elements put forth by the World Business Council for Sustainable Development (WBCSD), allowing designers in discovering the engineering parameters needed.

Knowledge management and collaborative Green design

Under the global manufacturing environments, how to integrate the information into the process of products development is very important; the first one would be worker’s orientation and concept changing. Dankwort et al. (2004) were of the opinion that the product's development included three steps: creation, conception and engineering. “CAX” conception had replaced “CAD” engineering education and training. The main classes would be the CAS/CAD/CAM class which increased the PDM, FEM and PLM. To manage the data for collaborate products, the classes were not only used to set up the standard or process integration, but was also used to combine new ideas and collaborative concepts during the products' design process. Sharma (2005) observed that the high potential technology should be emphasized on the ability to connect people, process and information, and he also developed the PLM framework to integrate the collaboration, product development, innovation with people, process and information.

Collaboration knowledge management could be separated into three parts: pre-collaboration knowledge, in-collaboration knowledge and post-collaboration knowledge (Yesilbas and Lombard, 2004). Before the collaborative design, pre-collaboration knowledge was the basic element of the team member, like the CAD, PLM; in-collaboration knowledge means popularization or synergy knowledge through knowledge exchange. Post-collaboration knowledge provided suitable solution and could also be found in data base immediately the collaboration knowledge provided suitable solution and could also be found in data base immediately the organization needed after pre-collaboration knowledge and in-collaboration knowledge steps.

In this research, a collaborative design framework and system development process for green innovative product was proposed through computer supported cooperative work (CSCW) tools for design engineers and partners in the supply chain. Therefore, knowledge management can support individuals or groups to create and share knowledge to solve problems or avoid mistakes in the firms (Argote et al., 2003; Nanaka and Takeuchi, 1995).

Computer supported cooperative work

Computer supported cooperative work is a new technology to support people in their needs to communicate
and to exchange information. Design was the most important applications of CSCW technologies. The CSCW techniques that were almost used on collaborative design systems include groupware techniques for facilitating communication among design team members and context awareness techniques for enhancing coordination among team members (Shen et al., 2008). CSCW group-supporting systems and applications will become more and more important for an increasing number of interconnected computers. Computer-supported teams include generally project-oriented (or goal-oriented) with important tasks and tight deadlines. The group members may be connected in the same place or may be attending an electronic meeting with the other members in a different place or at the same time (Santos, 1995).

Sometimes, computer-supported teams are formal groups with a lasting duration; other situations need ad hoc teams with a limited lifetime and other kinds of properties. The team interaction might be informal or formal, unplanned or planned, and structured or unstructured. This creates many possible ways and applications types in the field of computer support for groups (Soares, 1997). Although computers have been used to connect team efforts, the emerging concept of computer-supported groups differs from traditional computer support concepts. In this study, CSCW tools would be used to exchange conceptions, ideas and information in the knowledge management platform.

COLLABORATIVE DESIGN FRAMEWORK AND SYSTEM DEVELOPMENT PROCESS

In this paper (Figure 1), using the Johansen's time-location matrix to distinguish the message's category and feature (Santos, 1995). In Figure 2, a collaborative design process for green innovative product was proposed and shown. At the right hand side in Figure 2, collaborative design team includes; customer, marketing person, design engineer, manufacturing engineer and supplier in supply chain. Collaborative design team could share their knowledge synchronously and simultaneously through the CSCW tools. At the left hand side in Figure 1, collaborative design knowledge includes general product design knowledge, TRIZ innovative principles, green design directives and regulations. At the top of Figure 2, collaborative design process and knowledge management includes: product design and develop process, knowledge transformation and collaborative design information system development.

In Figure 3, products' developed process includes; products' design evaluation, products' design process evaluation, patents evaluation, construct design framework and method. The platform of collaborative design information system included construct framework of knowledge concept, develop framework of knowledge system, analysis and design system, and construct prototype system, observation and evaluation system. Therefore, the four parts of collaborative design process for green innovative product could be used to develop new products through computer supported cooperative work (CSCW) tools.

The collaborative design framework for green innovative product was proposed and shown in Figure 3. The collaborative design in this model consists of three layers: data layer, information layer, and knowledge layer, which separately deal with the collaborative (products) detail design, concept design and activities of knowledge management. The products data's exchange provided by the data layer is also used for data standard exchange; like IGES or STEP. Information layer provided information sharing with products design. In the knowledge layer, experience and knowledge can be provided to help decision-makers make the right choice. Therefore, if green design and innovative design could be integrated into the knowledge layer, it could be efficiently used to develop products for high value. Figure 4 shows the knowledge management platform of the used case and the information origins, while Figures 5 and 6 present
the knowledge management platform for Development of Category and the process used to demonstrate the procedures of the data exchange, information sharing and application.
CONCLUSION

In this paper, the collaborative design framework and knowledge management platform for green innovative product was proposed. This framework was made of data stream from designer, consumer, supplier to deliver, receive and feedback during the life-cycle and could also be used for data exchange, information sharing and collaborative decision-making through CSCW tools. The collaborative design in this model consists of three layers: data layer, information layer and knowledge layer, which corresponded to different levels from lower to higher in the design process. The lower layer could support the higher layer. The higher layer provided lower design with directives and regulations to avoid the wrong decision-making or the unsuitable design, and then delayed the products that entered into the market by increasing the production costs. However, the knowledge management platform was built and defined in this article.

This framework presented the new collaborative model to create new products and improve designing for extra-value increasing through the grouping knowledge. Since, many researches aimed at green design and innovative design, very few studies focused on collaborative design within knowledge management. In the future, we will try to build the prototype of knowledge management for the
Figure 6. Knowledge management platform for development process diagram.

green product design.

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REFERENCES


