

Research on Concurrent Design of Collaborative Product Commerce Oriented Discrete Manufacturing Enterprises

LIU Li-Lan(刘丽兰), YU Tao(俞涛), FANG Ming-Lun(方明伦), WANG Xiao-Hong(王晓红)

CIMS & Robot Center, School of Electromechanical Engineering and Automation, Shanghai University, Shanghai 200072, China

Abstract In order to fulfill the product concurrent design requirements of discrete manufacturing enterprises, this paper puts forth for the first time a Collaborative Product Commerce (CPC) oriented X2D (X to Design) theory, which can take Collaboration, Commerce and Concurrency (3C) into realization during the product design stage. At the same time, this research adopts VPN (Virtual Private Network) technique to ensure the security of product data and information during transportation. By building CPC-oriented and VPN-based framework of X2D product concurrent design system, the paper explores a way for discrete enterprises adapting to the drastically competitive market and performing their product innovation.

Key words collaborative product commerce (CPC), concurrent design, X2D, virtual private networks (VPN).

1 Introduction

Generally speaking, product concurrent design is localized within enterprises. With the incessant development of Internet and web-based application techniques, however, it is urgently needed to cope with the problems of product concurrent and collaborative design in discrete manufacturing enterprises. At the same time, traditional product development and product life cycle management mode can not satisfy customized requests accompanying the increasingly competition of global market place. Furthermore, the demands of corporation partners, markets and customers can not be manifested in product timely and effectively. For these reasons, modern enterprises (especially discrete manufacturing enterprises) need urgently a new method of product development and product life cycle management to bind together both the inner and the outer of enterprises to make full use of all resources. The emergence of Collaborative Product Commerce (CPC) theory provides a basic idea and framework to resolve the problems.

In this paper, the authors expand the concurrent

engineering application scope and integrate the isolated knowledge into product design process by putting forth a CPC-oriented X2D (X to Design) concurrent design theory. The method prominently combines the Collaborative, Commercial and Concurrent characteristics (namely 3C) of concurrent design, and provides an integrated platform for product resources in order to effectively bring together the customers and remote designers during the product development stage. At last, this research adopts Virtual Private Network (VPN) technique to ensure the security of product data and information during transportation, and constructs a CPC-oriented and VPN-based X2D concurrent design framework.

2 Functional Scope and Flexibility

The operation category and functional scope of concurrent engineering is commonly localized within a company or enterprise. With the incessant development of Internet, web-based application technique and product collaborative commerce, however, the design of product is gradually described as an interactive process between companies. Thus, it is essential to expand the application scope of the general concurrent engineering in order to satisfy the demands of discrete manufactures, and concurrent and collaborative developments of remote manufactured product. Fig. 1 indicates the comparison of functional scope and flexibility

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LIU Li-Lan, Ph. D. Candidate; Yu Tao, Ph. D., Prof.,

E-Mail: liu. lilan @jiren. com

of various manufacturing philosophies.

Fig. 1 explicitly reflects the development of manufacturing conceptions, and shows the adjustment of functional scope of concurrent engineering. By circumscribing the concurrent engineering within enterprises, the collaborative product commerce is fundamentally hindered, which farther misfit for the requirement of web-based collaborative design.

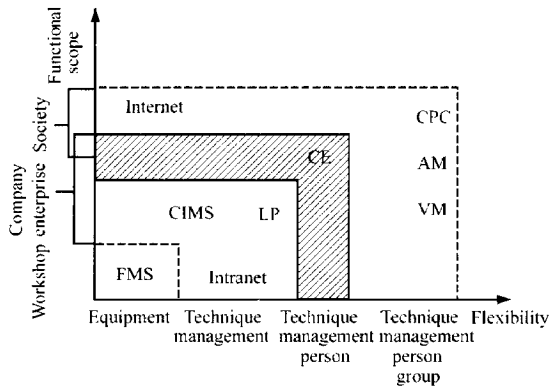


Fig. 1 Comparison of functional scope and flexibility

Therefore, it is inevitable for cooperation between companies and remote discrete enterprises of product developments to develop CPC-oriented product concurrent design theory.

3 System Framework

With the help of CPC, enterprises hope to resolve the following two problems. One is to make the collaborative work and share of information more conveniently among remote product designers and experts; the other is to integrate the customers' knowledge into the process of product design and development. Product designers can interact directly with the enterprises on product design, and define product specifications and other related data. Customers and experts can define product specifications and criterion by proposing requirements and advises through knowledge producer. By CPC-oriented enabler and technique, the designations of customers can be transferred into required files or drawing resources in order to satisfy the customers' particular demands for product manufacturing. CPC software and service permit more enterprises and customers in collaboration to participate in the process of product design in real time.

X2D is a CPC-oriented platform for product concurrent

and collaborative development, among which, X indicates any organizations and users who take part in product design and development, for instance, customers, experts and remote designers, et al. This platform provides a kind of loosely coupled integration of data and applications, depending on network techniques, encryption techniques, Web and distributed object techniques (for example, CORBA). The system framework is shown in Fig. 2.

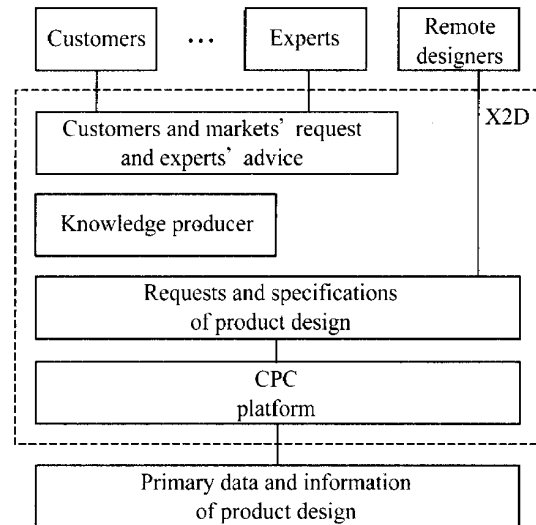


Fig. 2 CPC-oriented X2D concurrent design

The prominent benefits of using X2D concurrent design lie in that it allows the enterprise's decision-makers, who have experiences, knowledge and swift thoughtfulness, to centralize on product's life cycle management. It also helps them to adopt appropriate methods and tools to compete in the area of products' creativity and customers' satisfactions. It provides web-based tools for discrete manufactures to reduce required time from designing to manufacturing real product.

The CPC-oriented X2D concurrent design platform has the following characteristics: ① Related persons can participate in product design anywhere and any-time, that is to say, it has real-time attributes; ② It can satisfy individual requirement of participators in product design process; ③ Its primary task is product design and development; ④ It is based on mature network communication, security techniques and management system; ⑤ It can make concurrent and remote collaborative product design into reality. The ultimate purpose of X2D is to achieve the commercial

objectives of design anywhere and manufacturing anywhere, which makes it possible for collaboration among enterprises and integration of customers' knowledge.

4 Support of CPC to X2D

The basic framework of CPC is shown in Fig. 3. It is easy to draw a conclusion from Fig. 3 that CPC is actually a web-based resolution, which accomplish all activities in product's life cycle, by collaborating manufactures, suppliers, cooperation partners and customers through Internet. With CPC, enterprises can execute collaborative, concurrent work mode both internally and externally to make most profits.

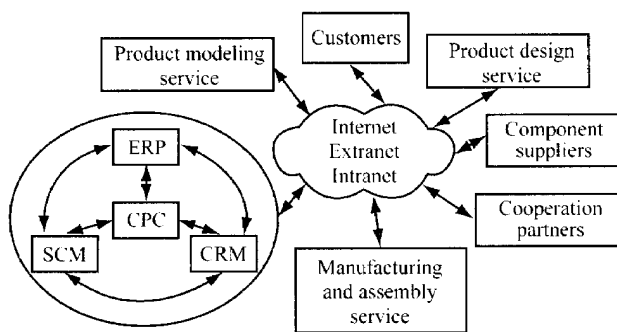


Fig. 3 Basic framework of CPC

4.1 Product development strategy

Compared with other concepts of product development, CPC especially emphasizes the roles of customers in product design. The creative solution is that customers can take part in product design directly during the research on design method and tools of product life cycle. With the help of computer networks, customers can make suggestions on the elementary product design before they are finalized.

Product is the cohesion and solidification of knowledge in nature. The process of product development and improvement is an innovative process to inherit the known knowledge and to accept the new knowledge, which comes from enterprises, cooperation partners, markets and customers, etc. In CPC-oriented environment, the efficient combination of new-style and distributed web-based collaborative work mode with Internet techniques brings a revolution to product design. Because CPC can integrate correctly the customers' knowledge in product development, it fulfills the product innovation for satisfying cus-

tomers, and exhibits the design capability of the enterprise.

4.2 The importance of collaborative work

It is generally considered that modern Computer Supported Collaborative Work (CSCW) is the main work mode in this century to support a group of users taking part in one design task, and to provide interface for them to share the working environment by constructing a computer system. At present, CSCW is one of the important techniques for CPC.

CSCW environment can change the manner of information flow among remote designers, diminish or reduce the obstacles brought by time and space. For these benefits, enterprises can use it to save time and energy of workers, improve work qualities and efficiencies, and take full advantages of concurrent design and manufacturing. Furthermore, it can take the product collaborative work in different departments, different areas and different time zones into possibility, which can obviously shorten product design and manufacturing time.

5 The Security Proved by VPN

Encryption, security and certification techniques are the important tools and components to ensure CPC functions effectively in enterprises. In this paper, we adopt VPN technique. The CPC-oriented and VPN-based X2D product concurrent design system framework is shown in Fig. 4.

We have the following four reasons for using VPN. The first is the security. VPN enables the Point-Point Protocol (PPP) safe for enterprises to guarantee the reliability, security and facticity of data when they are accessed and transferred among different intranets. The second is the non-localization. This concurrent design framework breaks through the traditional manufacturing mode, reaches over the inconvenience of different areas, different departments and different time zones, and establishes an information-share environment with uniform and friendly interface, which can take full advantages of concurrent design and manufacturing in different intranets at a remote distance. The third is the real-time alternation. With VPN as the physical supports, the network can be established when necessary. This ensures the reasonable utilization of network resources, and brings extremely the potential of network communication into action. The

last one is the expandability. The web-based distributed interactive system supports the functional of various share services of remote concurrent design and manufacturing, so it can make multi-intranets work together collaboratively.

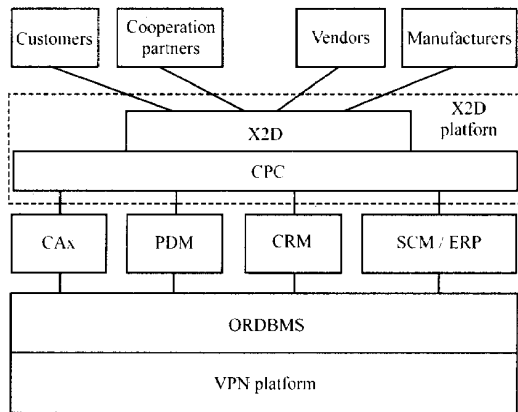


Fig. 4 CPC-oriented and VPN-based X2D system framework

6 Application and Conclusions

6.1 Application

An airline company is faced with serious challenge to accomplish the design and manufacturing of an advanced regional jet. One is the long distance between different participant departments of the company. The other is the lack of management and control to product information. The third is the inconvenience of sharing information among participants. The operation mode of the company is shown as Fig 5.

In order to solve these problems, the company decides to take CPC-oriented X2D concurrent design method. With its help, the company win the following results: ①managing the whole procedure effectively from market place, design and manufacturing to customer support. Ensuring the material, funds and information flow smoothly in the project; ②Manufacturers, suppliers, customers and directors can participate anywhere and anytime; ③shorten 30 percent development periods, cut down 60 percent mistakes, reduce 20 percent manufacturing cost, improve company credit and customer satisfaction.

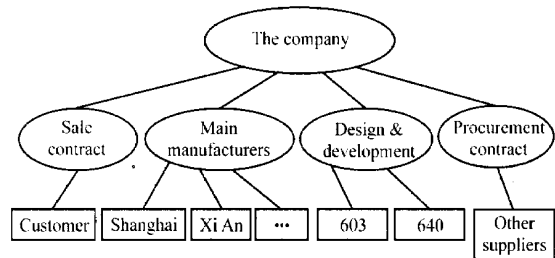


Fig. 5 The operation mode of the company

6.2 Conclusions

Nowadays, product concurrent design, remote design, effective management of data and collaborative work are not only the objectives that enterprises pursuit and the efficient measures to adapt to the changeable competitive market, but also a key for them to overtake the international advanced manufacturing techniques.

This article provides a CPC-oriented X2D concurrent design theory, which integrates customers' requirements and experts' advises, by using modern product development and management techniques of CPC, and analyzing concurrent engineering flexibility and functional scope. Finally, in order to guarantee the security of data, this paper constructs a CPC-oriented and VPN-based X2D product concurrent design system framework, which explores a way for discrete enterprises to adapt to the drastically competitive market and perform their products innovation.

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