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A System for Collaboration in Distributed Enterprises

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ABSTRACT

The information technology of computers and computer tools have become so powerful that virtual enterprises are not just concepts any longer. The virtual enterprises comprise distributed facilities and it is necessary to have a collaborative system among them. This paper proposes the modeling process of web-based collaborative system in the distributed manufacturing environment. It also presents the information infrastructure in order to communicate and to share the information more efficiently among the collaboration subsystem. The web-based collaborative system consists of four processes: 1) product design, 2) procurement of DB information, 3) query process, and 4) negotiation. The proposed web-based collaborative system will be implemented with network technologies.

Key Words: web-based collaborative system, virtual enterprises, negotiation system.

1. Introduction

1.1. Motivation and Definition of Collaboration

Virtual enterprises will be spread rapidly by information technology in the near future. Since the information technology of computers and computer tools have become powerful and come into wide use, users of internet have been increased. In the manufacturing sector, this trend becomes clear by jointing manufacturing ventures, increasing outsourcings and supplier partnerships with geographically distributed partners. Therefore it is no longer necessary to have centralized manufacturing facilities.

What is the definition of collaboration? Collaboration contains communication to share the information and negotiation to select the desired result. And also, it enables to update some shared design description via network in real time. Collaboration among manufactures accelerates the development and dissemination of basic manufacturing services. Also it minimizes the cost and time from idea conception to application, and optimizes the manufacturing quality.

And as the Web grows and its supporting infrastructure improves, delivering high-quality manufacturing services in this manner should become increasingly straightforward across the Web. That is to provide significant advantages in cost, accessibility, flexibility and ease of use to end users.

1.2. Purpose and Related Work

This paper proposes the modeling process of web-based collaborative system in the distributed manufacturing environment. And then it presents the information infrastructure in order to communicate and to share information more efficiently between collaboration subsystems. It also presents the scope of virtual enterprises in the future.

The related work for the collaboration in distributed enterprises is shown in Figure 1.

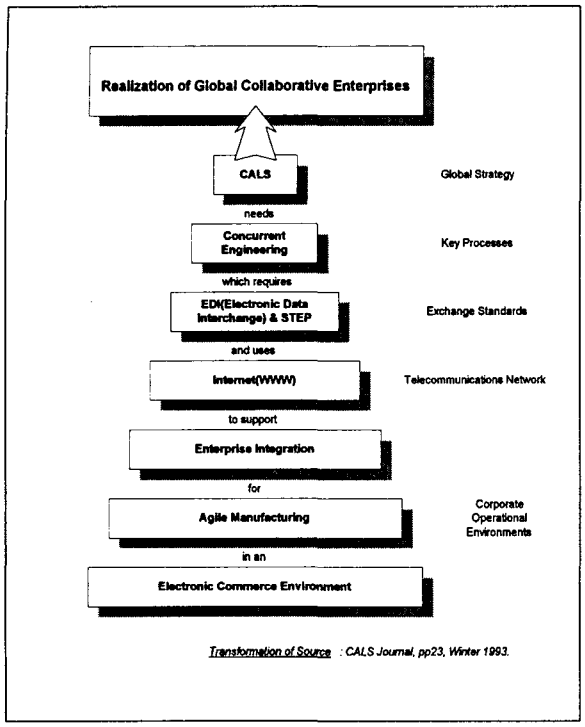

Figure 1. Related Work for Global Collaborative Manufacturing

2. Collaborative System of Distributed Enterprises

2.1. Why Do We Need the Web?

A variety of manufacturing support services are possible for the WWW portion of the internet, including 1) software for engineers concern with design for manufacturability, 2) simulation of manufacturing processes, 3) part fabrication (submit CAD model to a server and receive a part by mail), 4) testing (mail a part to a laboratory and receive the test data electronically)[1]. How are data shared in the internet? That is achieved by internet tools and services - through servers using the hypertext transfer protocol (HTTP). Hence data are available to users anywhere on the Web with minimal local hardware and software requirement. Why do we need the Web? The reasons are: 1) possibility of sharing information regardless of differences in the individual information technology systems, 2) possibility to use other's computing power, 3) providing significant advantages in cost, accessibility, and flexibility, 4) ease of use by end users - easy installment of new documents, data, or software so they are immediately available to millions of potential users, and 5) shortening the product design life cycle.

2.2. Process of the Collaborative Systems

The process concept of global collaborative systems is shown in Figure 2. The explanation follows in section 3.

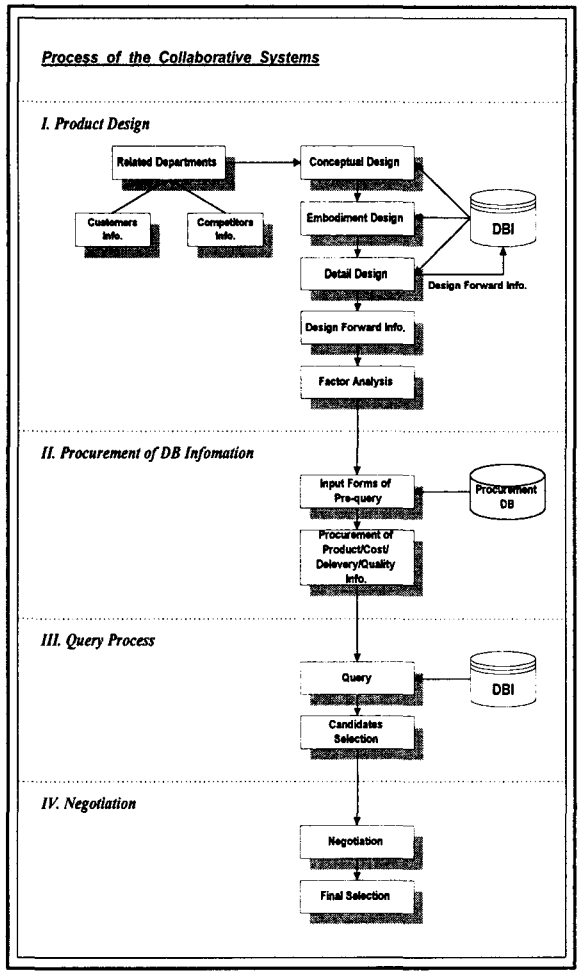

Figure 2. Process of Collaborative Systems

3. Stages of Collaborative Systems

3.1. Product Design

The purpose of this phase is to realize customer-based product for success in the market, through the negotiation system among the experts of functional departments. The main flow of the work during the design process is as follows: 1) clarification of the task, 2) conceptual design, 3) embodiment design, 4) detail design, and 5) factor analysis.

3.1.1. Product Planning and Clarification of the Task

In this phase, the functions of enterprises collect the information about competitors, the requirement of customers, and the product specification.

3.1.2. Conceptual Design

The purpose of conceptual design is to establish part of the abstractive design process by the identification of the essential problems. It finds appropriate solution principles and combination through discussion and sample testing.

3.1.3.Embodiment Design

The role of embodiment design is to form the part results of the concept design according to technical and economic criteria, after which the design is developed.

3.1.4. Detail design

This is the process of the design in which the arrangement, form, dimensions and surface properties of all the individual parts are finally laid down. The material is specified, the technical and economic feasibility are re-checked and all the drawings and other production documents are produced.[2]

3.1.5. Factor Analysis

The purpose of factor analysis, which allows the effect of each and every factors to be estimated and tested independently through the usual analysis of variance [3], is to select main component, through simulation using the test-bed, which affects the success in the market.

3.1.6. Styles of Design Information

The design information is divided into foreground information and design background information (DBI).[4] Foreground information consists of engineering drawings, CAD data, and product models, etc. DBI contains history reference, design requirements, design intents, design methods, design standards, standards parts, design history, design modification records, engineering analysis records, and manufacturing process/resource information, etc.

3.2. Procurement of DB Information

A successful infrastructure should be able to communicate information as rapidly, safely, cost-effectively, flexibly, and portably as possible. This information infrastructure combines DB information for procurement in the distributed enterprises, and then accomplishes collaboration, which enables virtual enterprises. Therefore, this infrastructure has three necessary components: 1) CORBA to allow applications to use other's resources by supporting message calls among objects through a network, 2) STEP to be standards for exchange of product model data, 3) WWW, communication protocols to access data across the internet. Information infrastructure architecture is shown in Figure3.

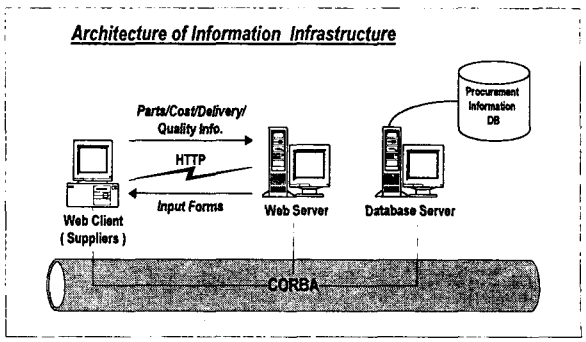

Figure 3. Architecture of Information Infrastructure

3.3. Query Process

The purpose of this stage is to select the candidates for collaborative work through DBI and selector's experience.

In this stage, the most important is to adopt constraints for query. Firstly, these constraints are extracted by decision-maker's experience, DBI in the enterprises, and strategy of competitors. Secondly, experts discuss about the constraints of query for initial goal through brainstorming. Thirdly, the best manager selects them. Finally, the expert formulates the optimal solution in cost, time, and quality with selecting constraints. And then, query execution is operated by procurement information DB.

3.4. Negotiation System

The goal of the negotiation system is to shorten the decision-making time and product design life cycle in spite of distributed location. Thereby, virtual manufacturing system will be realized.

The concept design of the negotiation system is as shown in Figure 4.

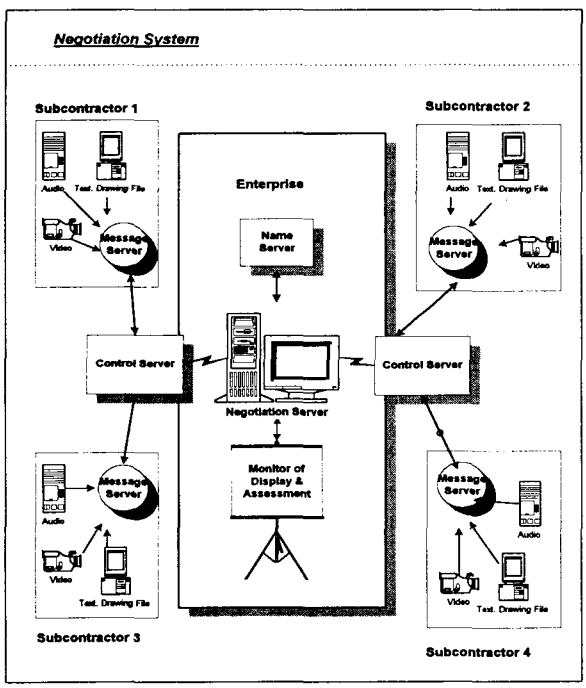

Figure 4. Negotiation System

This negotiation system consists of four servers. These servers are as follows: 1) message server to package the functions of media and the files at each subcontractor, 2) control server to convert the functions of other applications and to schedule, 3) name server to have directory of all subcontractors, and 4) negotiation server to manage the forum by selecting the forum rules, and scheduling the progress.

The role of negotiation system is to provide computer support for the conference of synchronized multimedia communication among the distributed subcontractors.

Therefore in this phase, final subcontractor is selected through comparisons among the participant's technologies on the negotiation server monitor.

4. Conclusion and Future Work

When the virtual enterprises are accomplished, they will allow engineers not only to see pictures and CAD drawings of the products but also to simulate and correct in real time. Also, they enable top-managers not only to select good subcontractors in the quality, time and cost, but also to trade on the distributed enterprises. And then the virtual enterprises with collaborative system of this paper will have much stronger competition in the global market.

The future work will be to implement collaborative system with advanced inter-networking technologies for realizing virtual enterprises. The results will be as follows: a Java-based interface for a three-dimensional CAD system not only allows enterprises to put catalogs on the Web but also enables potential customers and other enterprises to examine products in three-dimensions, and to simulate in real time. Therefore, virtual market will come true as soon as possible.

At the moment, we are planning to experiment the collaborative system with a test-bed on the Web. In the future, we will apply this system from the collaborative system for procurement to all the manufacturing supply

chain.

5. References

[1] J.W.Erkes, K.B.Kenny, J.W.Lewis, B.D.Sarachan, M.W.Sobolewsky, and R.N.Sum.Jr, "Implementing Shared Manufacturing Services on the World-Wide Web", *Communication of the ACM*, Vol. 39, No. 2, February 1996 , PP 34-45

[2] G. Pahl and W. Beitz, *Engineering Design a systematic approach*, The Design Council London, 1993, PP 38-314

[3] Ronald E. Walpole and Raymond H. Myers, *Probability and Statistics for Engineers and Scientists*, Maxwell Macmillan International Editions, 1990, PP 463-479

[4] H.Suzuki, F.Kimura, B.Moser, and T. Yamada, "Modeling Information in Design Background for Product Development Support", *Annals of the CIRP* Vol. 45, No. 1, 1996, PP 141-144

[5] Martin Hardwick, David L. Spooner, Tom Rande, and K.C.Morris, "Sharing Manufacturing Information in Virrual Enterprises", *Communication of the ACM*, Vol. 39, No. 2, February 1996 , PP 46-54

[6] Davie M.Upton and Andrew McAfee, "The Real Virtual Factory", *Harvard Business Review*, July-August 1996, PP 123-133

[7 Feniosky Pena-Mora, Karim Hussein, and Ram Duvvuru Sriam, "CAIRO: A system for facilitating communication in a distributed collaborative engineering environment", *Computers in industry* 29(1996), PP 37-50

[8] Steven L.Goldman, Roger N. Nagel, and Kenneth Priss, *Agile Competitors and Virtual Organizations*, LEE IACOCCA, 1995, PP 3-181, PP 201-234

[9] The Agile Manufacturing Project at MIT *(http://web.mit.edu/ctpid/www/agile/)*

[10] Agile Enterprise Project Mission *(http://absu.amef.lehigh.edu/AEP/aep.html)*