

Virtual Enterprise Oriented Enterprise Strategies and Cooperative Product Design System Development Based on J2EE MVC Mode

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Abstract: *Based on the analysis of the background of virtual enterprises, the framework and strategies of virtual enterprise oriented enterprises are put forward. The process control of cooperative product development in the virtual organization is also discussed where the hierarchical architecture of the dynamic relations among tasks, processes, and resources is presented. Based on J2EE platform and Web, MVC (Model-View-Controller) mode is adopted to develop a cooperative product design prototype system for the virtual enterprise that is used to verify the presented strategies.*

Keywords: *Virtual Organization, Management, Architecture, Process Control, J2EE, Web, Cooperative Design*

1 Introduction

Because the important effect of manufacturing on economical and political status of nations and its crucial role in 21st century industry^[1-2], a more competitive environment is coming into being from a global point of view. In the consumer oriented age, virtual enterprises and supply chain^[3-4] can respond rapidly to the market changes, grasp users' requirements and needs, and provide them with satisfying products and services. Enterprises are depending more and more on their partners and make them to take charge more and more important business activities, which include design, distribution, transportation, and so on.

Faced with processing time uncertainties, equipment reliability/availability, demand changes, manpower fluctuations and so on in a dynamic manufacturing environment, different considerations must be taken into account when efficient and effective virtual enterprises and organizations are established. In the paper, the framework and strategies of virtual enterprise oriented enterprise are presented to close integrate various resources from different enterprises, to share information and business process and technologies, and to bring their potential into play.

2 Virtual Enterprise Oriented Enterprise Framework and Strategies

The virtual enterprises can bring great profit for enterprises, at the same time, its implementation has great influence on many aspects of the enterprises, such as product development, organization, management, technologies, personnel, etc. Therefore, modification and transformation are needed. In the paper, virtual enterprise oriented enterprise framework and strategies are discussed at three levels, namely strategic level, tactical level and operational level. Under the support of common infrastructure, the overall optimum functioning can be achieved through distributed cooperation. The framework is shown in figure 1.

2.1 Strategic Level: Agility Management

Faced with the complexity of rapid changes, at the strategic level of the enterprises adapting to the competing pattern of virtual enterprises, the following aspects should be taken into account.

- 1) Respond quickly to the changes of environment.
- 2) According to the outside variety, identify and consolidate core competence.
- 3) According to consumers' needs and the capabilities of the enterprise, carry out business decision-making to determine the types, scale, performance, and specification of the product to be developed, and fasten product development to agilely respond to market diversification.
- 4) Run effectively and efficiently, and improve continually.
- 5) Construct the infrastructure suitable for the business done in the virtual enterprises.

6) Enhance and develop the capability of innovation, reconstruction and transformation.

2.2 Tactical Level: Management of Core Competence

1) Reform the organizations, managing strategies and systems to make the enterprise virtual where comprehensive education and reconstruction of wide scope are needed.

2) Realize concurrent and flexible product development during the whole developing cycle by utilizing information technology and advanced manufacturing technology.

3) Cooperate with other enterprises, colleges, and institutes to rapidly combine and establish production resources to respond to the changes of business, engineering, and production.

4) Let consumers take part in the developing course, and enhance information service and system management.

5) Create conditions to make personnel to exert their initiative and innovation.

6) Adopt flexible automation in production to achieve flexible manufacturing.

7) Establish virtual enterprise oriented infrastructure. As the running pattern of the enterprise is changed, the corresponding infrastructure should also be changed and improved to adapt to new requirements.

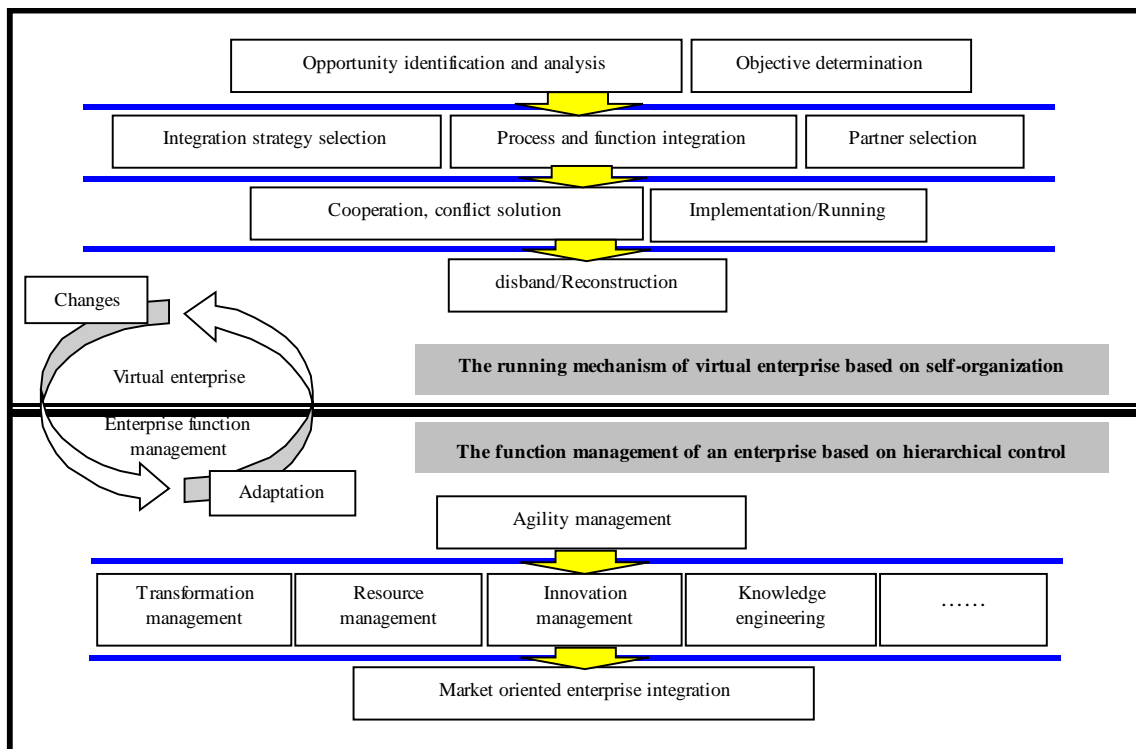


Figure 1 Virtual enterprise oriented enterprise framework

2.3 Operational Level: Market Oriented Enterprise Integration

1) Enterprise integration is achieved on the basis of information integration, function integration, process integration, resource integration, etc. Aiming at rapid product and process realization, the entire development cycle will ultimately become virtual.

2) Develop and enhance core competence through knowledge engineering and innovation. Knowledge engineering and innovation are the foundation for the enterprise to enhance its core competence, while core competence is the precondition for the enterprise to survive and evolve.

3) Reform organizations and management actively. Through task decomposition and self-adaptive distribution, the relation between partners and cooperation pattern are determined dynamically.

4) Human centered resource management integrate other resources around personnel to form integrate intelligent units (IIUs). IIUs can be combined to form teams of different granularities and functions according to the tasks to be done. The rest may be deduced by analogy until the whole organization and resource allocation are accomplished. Moreover, the complexity of resources is simplified, and human enthusiasm is activated.

5) All business and developing activities are support by integrated, mutually operational information infrastructure.

3 The Dynamic Hierarchical Relation Between Tasks, Processes and Resources in the Virtual Enterprise

Process control and management of the virtual enterprise run through all its lifecycle, and should synthetically consider every aspect of its lifecycle from its establishment, such as social and cultural infrastructure, business process, laws and rules, workflow plans, storage and logistics, equipment, physical limits, etc. The virtual enterprise usually go through five stages, namely opportunity identification, partner selection, organization formation, enterprise running, and disband and reconstruction.

In its lifecycle, partner selection, organization formation, and enterprise running affect one another. Process control can be divided into task level, virtual process level, and resource management level, where developing tasks are described, decomposed, distributed, synthesized, and managed at the task level, process decomposition, functionality, and logicity are presented at the virtual process level, and various kinds of resources needed in product development are described, organized, and managed at the resource management level, as shown figure 2.

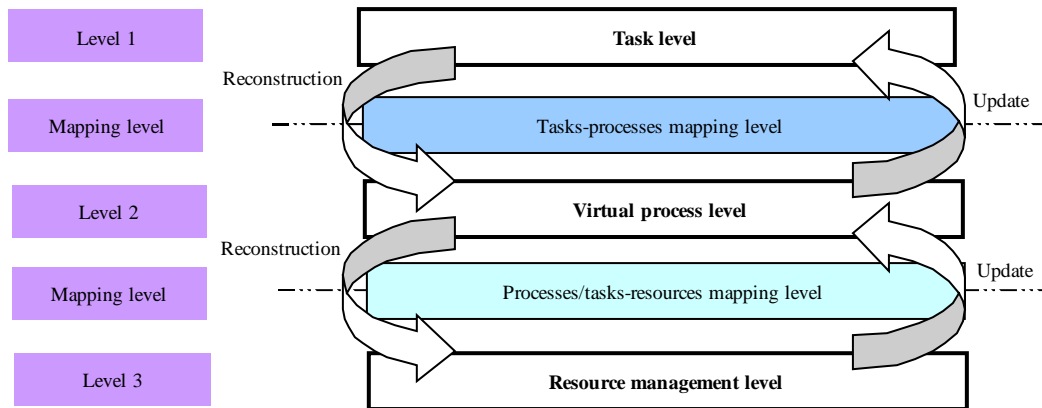


Figure 2 The dynamic relation between tasks, processes and resources in virtual enterprises

Because the tasks, virtual processes and resources vary continually and affect one another, it is through task-process mapping level and process/task-resource level to realize dynamic reconstruction and update at the tasks, process and resource level. Thus, tasks and processes of different partners can be coordinated and controlled and the virtual enterprise runs as a holistic one. All activities are organized according to virtual processes. The workflow among the partners can be decomposed into sub-processes that run in different departments and enterprises. In order to optimize its management, the relations and parallelism between processes are analyzed to form comparatively self-governed tasks, processes and organizations. After decomposed to sub-tasks and sub-processes of certain granularities, the tasks and processes are assigned to the resources of corresponding granularities at the process/task-resource mapping level.

4 Cooperative Product Design System Development for a Virtual Enterprise Based on J2EE Platform

Based on J2EE platform and Web, MVC (Model-View-Controller) mode is adopted to develop a cooperative product design ^[5-8] prototype system for the virtual enterprise. After the framework and data model of the prototype system are analyzed, its main functional modules are realized.

J2EE three-layer application architecture is used to develop the system, as shown in figure 3. At client level, browser and HTML pages are used to realize View functions. At Web server level, Controller functions are realized using Java Servlets and some View functions are realized using JSP. Data Model is realized using JavaBean that is connected to database level.

The use case of the prototype system is shown in figure 4. It systematically reflects the functions and workflow of cooperative product design on Internet. Hereinto, users are divided into six species according to their authorities, namely system administrator, project manager, task manager, designer, expert, and common user. Considering system security, each species must log in the system and be certified before he can carry out corresponding manipulation. For example, a system administrator is mainly responsible for the maintenance of information and data, certification of new users, system security, etc. A project administrator is responsible for the creation of new product design project, maintenance of existing projects, resource assignment, monitoring and controlling of project progress, etc.

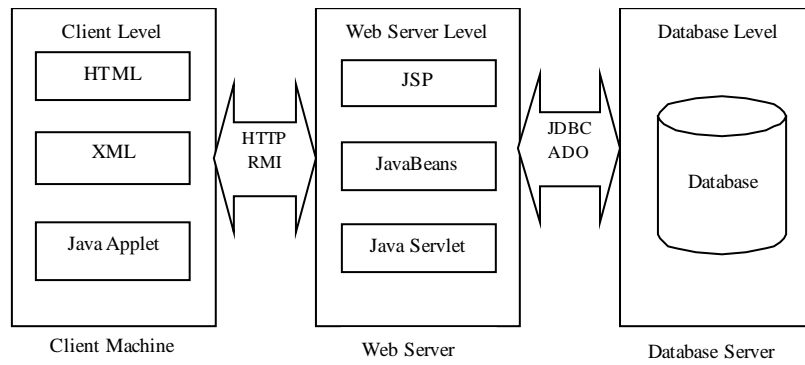


Figure 3 The implementation mode of the prototype system

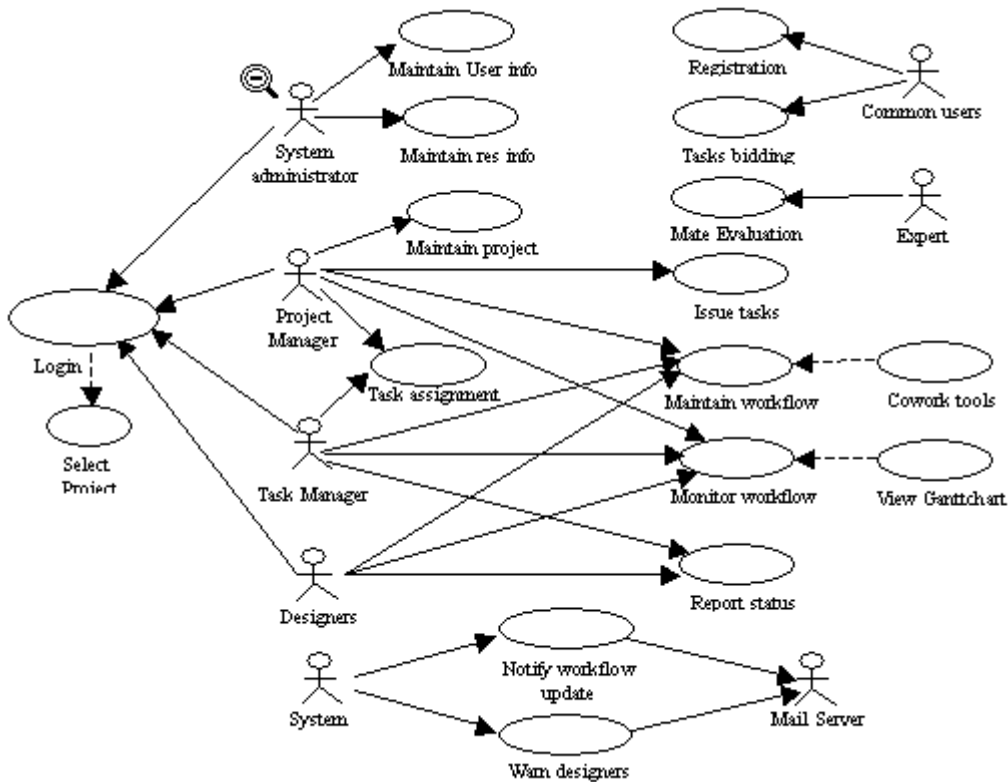


Figure 4 The use case of the prototype system

Due to the MVC mode adopted, data processing, program interface and control logic of the system are separated. The composition of functional modules of the prototype system is shown in figure 5.

5 Conclusions

The implementation of virtual manufacturing should begin with organizational, managing, and cultural aspects, and then extend to technological aspects. The transformation of organization and management lays a foundation for the enterprise taking advantage of advanced manufacturing technologies and methods to achieve greater benefit. There is no invariable principles to guide the implementation and running of the virtual organizations. In the paper, the establishment, management, and framework of virtual enterprises are studied. The implementation of the virtual organizations should begin with one or several aspects suitable for the enterprise, and evolve with the development of the enterprise. Although virtual enterprises provides measures for enterprises to cope with the challenge of future manufacturing, it seems more important for any enterprise to enhance and develop its core competence. Based on J2EE platform and Web, a cooperative product design prototype system for the virtual enterprise is developed based on J2EE MVC mode to verify the strategies put forward in the paper. It has been used to the design of machine tools on Internet. According to testing results, some technologies, such as

process fusion mechanism, dynamic process reconfiguration mechanism, partner selection based on grey relation analysis, distributed resource management and assignments, and so on, are the emphasis of further researches.

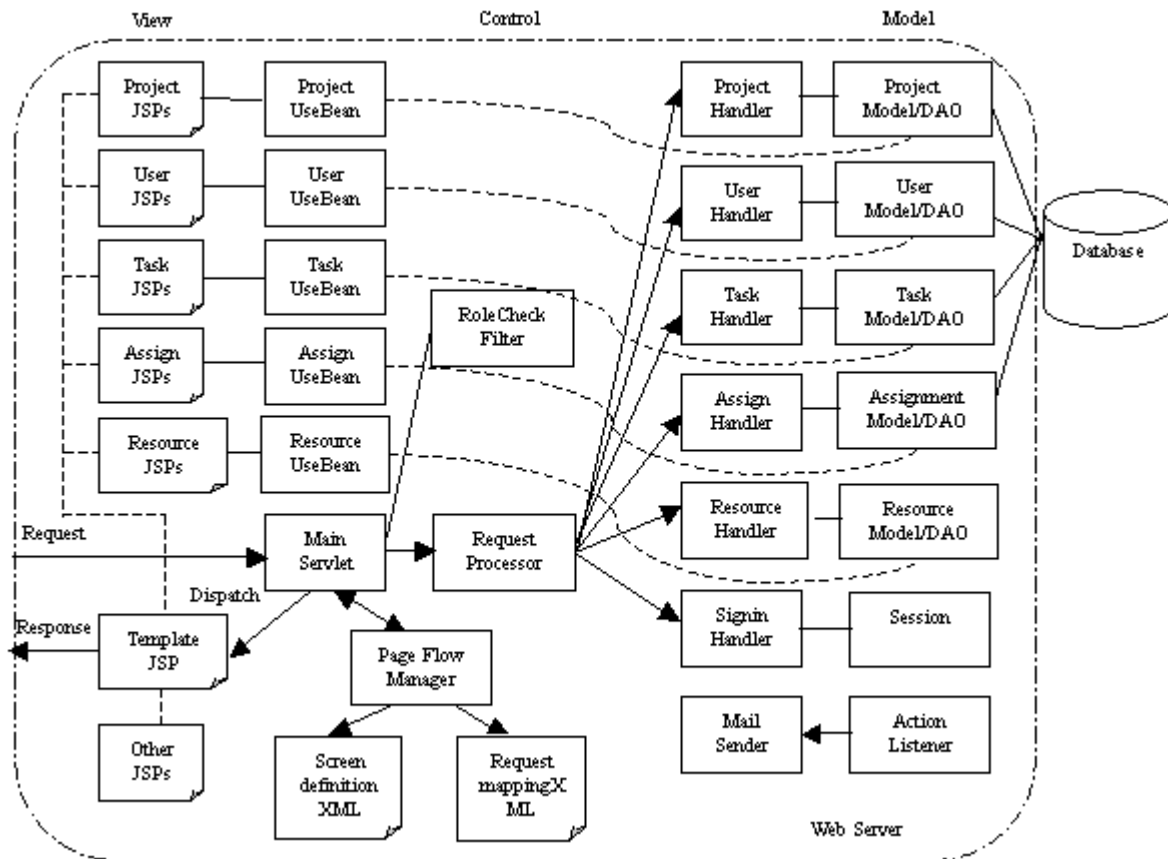


Figure 5 The groupwares of prototype system based on MVC mode

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