

# DISTRIBUTED COLLABOTATIVE DESIGN MANUFACTURE ESSENTIAL TECHNOLOGY AND SYSTEM REALIZATION SOLUTION

Wu Zhiyun, J. Wróbel

Inner Mongolia University of Technology  
Warsaw University of Technology  
e-mail: willie323@163.com, Jerzy.Wrobel@simr.pw.edu.pl

**Keywords:** Distributed design, Collaborative work, Web

**Abstract:** *The distributed collabotative work system based on the web -CWS(collabotative work system) after analyzed characteristic of manufacture system based on Internet is introduced in this paper, and structure, the function and essential technical realization of the system is discussed in detail either.*

## 1. SYSTEM STRUCTURE OF CWS

### 1.1. System structure

According to the disperser web manufacture characteristic, we use the browser/server (B/S) pattern, has developed CWS based on the web. This system is open style, the security, videotext, multi-purpose, and supports the multi-disciplinary personnel on-line to develop differently region collabotative design manufacture. Its system structure as figure 1 shows.

This system takes supporting the different region real-time collabotative design manufacture as a goal, takes the videotext design manufacture and the community decision-making as the method, takes the data storage and the transmission security as the safeguard, thus can truly support the different personnel on the local area network(LAN) and wais to collabotative work.

The system has provided the consistent web contact surface for the user, may realize the cross platform work. B/S structure which the system uses is one kind of client pattern. The client end only installs the browser, and according to needs to download the application procedure which needs. Majority of processing places on the server. This pattern will reduce the maintenance work burden on the client end, is easy to manage, maintain and upgrade edition.

### 1.2. Based on module programming method

The system has used programming method based on the module. Based on the module application procedure is composed of the relatively independent module, which can substitute the old module with

the new module and establish brand-new application module in the module that has been with the technical unceasing development and the customer request. Hence, this system has inheritor and the extension. Using the module object model technology to realize various functions module seal is advantageous to the system transplant, the reorganization and the development. At the same time, through module model of client end downloading, the system may realize the special application demand, satisfies the complex design of the collabotative system.

The above characteristics adapt specially in the web application system skeleton. The web application system needs to meet the different client side need by the flexible system module way. And according to the user, needs to carry on the reasonable combination and the disposition. CWS which we developed applies in the windows platform, and uses the COM standard.

ActiveX standard is a kind of open standard which is based on COM. Controls that are devised based on the ActiveX standard is one kind of special COM module that can be used to the web page. Through applying ActiveX control to the client end and the server end, and carrying on the server and the client end correspondence with the network communication technique, we may realize the special network correspondence and collabotative application, and also develop the safe correspondence agreement which may be controlled to realize material transmission of the special security requirements.

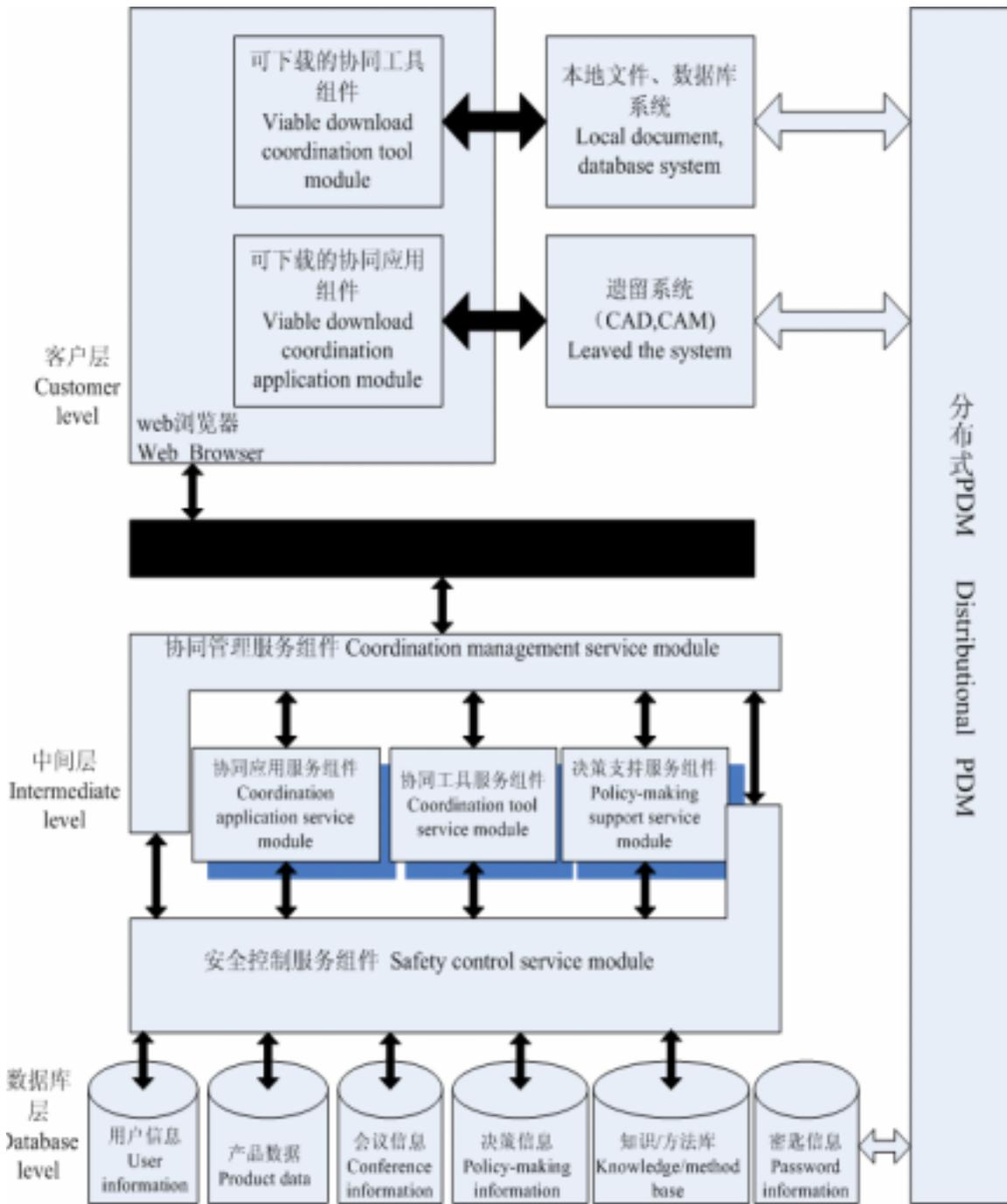


图1 基于Web的协同工作平台体系结构  
Fig.1 The architecture of Web-based collaborative

## 2. COLLABORATIVE TECHNOLOGY

### 2.1. Project management

Different region collabotative design manufacture is the complex active processing, therefore needs to make the overall plan for each kind of activity and the resources in product design manufacture from the overall situation angle. So, it can complete the entire process in the scheduled time by high grade and the low cost.

Project management includes two aspects: First is the project organization. It effectively manages each kind of resources and the data which the project needs according to the project characteristic, the project plan and reasonable organizing personnel which revolves in the project, in order to guarantee the project smoothly completes according to the plan. Second is the project control. It tracks its progress, grasps its each work present situation, in order to carry on the suitable resource distribution and the progress adjustment. The project management system of this system takes the progress

management as a center, realizes definition, the management, the execution and the monitoring for the duty flow. The project supervisors manage the system and the design group may share resources (data, documents, design tool and so on) under the certain jurisdiction. This system project administration module mainly has decomposing project, assigning sub-duty, disposing the organization and the resources, the modeling tool, the duty plan, the duty execution engine, the monitor of duty flows, the duty description table, monitoring the project progress, the historic record and the application tool and so on.

## 2.2. Work flow management

The work flow management is one kind of process management technology that can make the multi-people who are in different region and on different time to collaboratively work. Its goal is partly or completely realizing automation of duty process. The work flow the management mainly divides into two stages: the modeling and running. The modeling of the work flow is the work which may change the realistic model into the modeling of the work flow that can be understood by the computer, thus realizes control, management and optimization of operation process with computer information system. It includes the active function of the description work flow, of the relative definition each other and determining the work flow, its step, so on active outset, conclusion condition, corresponding application and role relation and so on. After the model of the work flow is created, it is saved in the work-flow-model storehouse of work-flow management system.

After the work-flow model is touched off by the external condition, the system creates the work-flow example and gives it to work-flow engine to explain and execute. The work-flow engine dispatches resources which the duty needs, controls duty's start, end and running status, maintains documents and data in work-flow and operates them according to the definition, thus impels the running of the entire work-flows. In CWS, the individually work-flow needs to be allowed to use many servers and the client end on the wais, in order to control and manage enterprise operation process with the parallel computation, sharing resources and the distribution operation. The web technology and the Distributed object technology are good to support work-flow system.

The project management is level management in the macroscopic. It monitors executive situation of analysis project from macroscopic, dynamically adjusts resources assignment, control project to effectively complete according to flow planned. But, the work-flow management is level management in the microscopic. It drives the different region collaborative design manufacture process with work-flow, and realize "in correct time, the correct information is transmitted to correctly human on correct the place" goal. Through integration of the

project management and the work-flow management, we may guarantee different region collaborative design manufacture to be completed according to special progress and the standard and enhance the quality of process management.

## 2.3. Distributed data management

Data type in the product development is extremely complex. In CWS, because the multi-people use these data, we need the system to provide the effective data management function. In order to guarantee that we can easily, consistently and safely use these data, CWS brings forward the new request to the data management. There are next several aspects:

(1) Support distributed environment. Because the personnel who participate collaborative design are different in geographical position and use different computer system, data management system is requested to have distribution handling ability, and can effectively transmit data between different systems.

(2) Edition control management. The collaborative work is a kind of exploitive work in which many personnel are busy with. It involves much temporary data and has many editions, therefore the system is requested to effectively manage data that belong to different owners, are different edition and are designed for different goal.

(3) Jurisdiction control. In order to be safe, the object developed, the database resources and each kind of development personnel are given the certain jurisdiction. It can control some illegal user not to visit or modify database.

In view of the above characteristic and the request, CWS separates the data management system and the collaborative application procedure. The collaborative application may be run on one or many client computer, and carries on the communication with the data management system. Front end system of client processes all screens, user input/output and part operation on local computer. The data on client end are saved with Microsoft Access-individual relational database which copy data of CAX application data in the sharing database, the data of the work edition and the freeze edition and partial or temporary data of local application subsystem. Rear end system of the server mainly carries on the data management and maintenance. The sharing database uses the Microsoft SQL Server multi-user relational database to save the sharing data of system, provides the data support for the system operation.

## 2.4. Dynamic data management

In the collaborative design manufacture process, data in the product edition is used possibly by many specialists, or a specialist also possibly produces an object that has many editions. Moreover, the design is a repeated and choice process, it has the repeatability, experiment, the interaction and

expansibility. Therefore edition can be merged, deleted and so on. Obviously, we need the appropriate edition management mechanism to enable the authorized group personnel to visit the correlation data as necessary, and understand these data state. At the same time, by the edition change process control, we can maintain uniformity of the engineering design information and provide the effective support to the design in revision.

In the coordination design manufacture process, the design object edition presents 3 characteristics, namely multi-editions, dynamic and relatedness. The meaning of multi-editions is some design object to have many editions in the identical time. In the collaborative design manufacture process, the multi-editions formation relates to the characteristic of many members' disperses in the space and the time. Dynamic characteristic means change of the edition. Each edition has own life cycle, some specific condition in some time and causes its condition transformation if you operate the edition. The meaning of relatedness is the interdependence between the product edition items, also means changing process of identical product edition. The new edition of product is obtained after the old edition is amended. Between the edition and the edition has the derived relation. We use the product edition object to demonstrate the description edition information, and express the relations of the editions with the relational object. Thus, when the edition is created or changed, the product edition object has preserved the information.

In the design process, we deal with edition in different way and change the condition of the edition. Typical edition processing has creating edition, merging edition, edition proofreading, edition verification, issuing edition, revising edition, deleting edition and so on.

CWS has provided each method of edition operation, thus enables the design personnel to easily complete the treating processes of edition, effectively manage the dynamic data.

### 3. SECURITY TECHNOLOGY

#### 3.1. Access control

CWS is multi-duties and multi-user Distributed system based on the project, the different user completes the different task in the project, thus

has different operation jurisdiction to the information. The access control is an important mechanism to realize the safe Distributed information system. The access control defines which kind of main body has which kind of operation authority to which kind of object. Its goal is to allow the user carry on the pre-definition visit to the system information which is authorized to, limits other users not to optionally delete, amend or the copy information file. The access control technology also may cause the system manager to track user's activity in network, promptly discover and reject invasion of heck.

#### 3.2. Security of data transmission

In CWS, the massive data need to transmit on the public network, internet's distribute universality, route's randomness and agreement's openness take the data easily to be stolen by the competitor. In order to guarantee safe data transmission between the group collaborators in different region, it is necessary to carry on the privacy communication. Because of correspondence form multiplicity and the correspondence object complexity in the CWS, the privacy communication needs very much technical support, including design of encryption and decipher algorithm, password authentication technology, password assignment management and so on.

The safety control service of CWS is to realize the above functions.

### 4. COLLABOTATIVE APPLICATION EXAMPLE

Take the shell as the example, the process description of different region collaborative design manufacture as follows:

First, the project supervisor decomposes project and creates work-flow model with the collaborative administration module, then establishes the work-flows model used in T/R module design, carries on the duty assignment (Figure 2) and carry on the collaborative design manufacture which is derived by work-flow the engine.

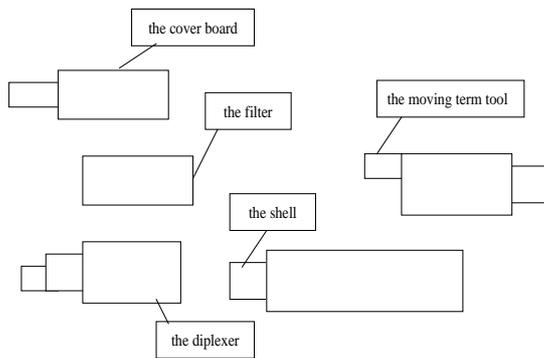


Fig. 2. The composition of T/R module

On the basis of task book, design personnel manage CAD application module to process shelly part design based on character. In course of design, composer can use the tools of restrictive management to process restrictive modeling and restrictive examining, at the same time composer can also use decision-making sustaining tools at home to put up synthesis value about character. To accomplish design, it is put in examining and approving personnel to process examining and approving. Examining and approving is processed according to request after examining and approving personnel receive examining and approving task and will examine and approve data of part. If part is found to need repair, design personnel will be asked to hold a meeting for processing modification together. Design personnel and examining and approving personnel can process modification about the part together when meeting is initiated successfully. In course of modification or after accomplished modification, decision-making sustaining tools can be used to process decision-making group; arranging could be processed when opinion couldn't manage to accord.

After the design of part, the technologists use the CAPP system processing technical design, and create part machining technical files, by which can instruct the CAM system to create part machining NC program. Virtual manufacture module use inborn NC program to do virtual process in virtual manufacture condition, also examine produced program and part, finally, the eligible NC program was carried to different numerical control machine tool for doing process by long-range control system. According to above mode, we can use CWS collaborative design manufacture system to accomplish the whole T/R groupware of design manufacture work.

## 5. CONCLUSION

Network manufacture is the main produce mode of the manufacturing in 21st century, and different collaborative design manufacture technology is the important guarantee to raise the market competition of enterprise in global. This text puts forward a system structure of different collaborative design manufacture technology based on Web, and opens out an application flat roof. This system adopts structure of B/S, also uses the main technology of computer network, COM groupware, collaborative work management, distributed data management, safe control, restrictive management and cleared up conflict, etc, and actualizes network different collaborative design manufacture.

## References

- [1] S. H. Kang, N. K. Kim, P. O Grady. Collaborative Design Using the World Wide Web. Technical Report TR97-02 ,Iowa Internet Laboratory, University of Iowa.
- [2] Z.Zhang, F.Cheng. Collaborative CAD on Web. Proceedings of 1999 International Conf. OnAdvanced. Manufacturing Technology Xi'an, 1999.
- [3] Jerzy Wrobel, Wu Zhiyun, Remote Engineering Data Exchange In Concurrent Engineering, VII Polish-Slovakian Scientific Conference "Non-classical material models in engineering design" Poznan , September 2002.
- [4] Wu Zhiyun, J.Wrobel, Language Conversion System used for Remote Engineering Data Exchange, 8<sup>th</sup> International Conference on Theoretical and Experimental Problems of Material Engineering Slovakia, Sep. 2003.
- [5] I. J NamD, K. Wright. Collide: A Shared 3D Workspace for CAD. Proceedings of the 4th International Conf. on Networking Entities, NETIES'98 Leeds, UK, 1998.