Establishment of Global Design Environment

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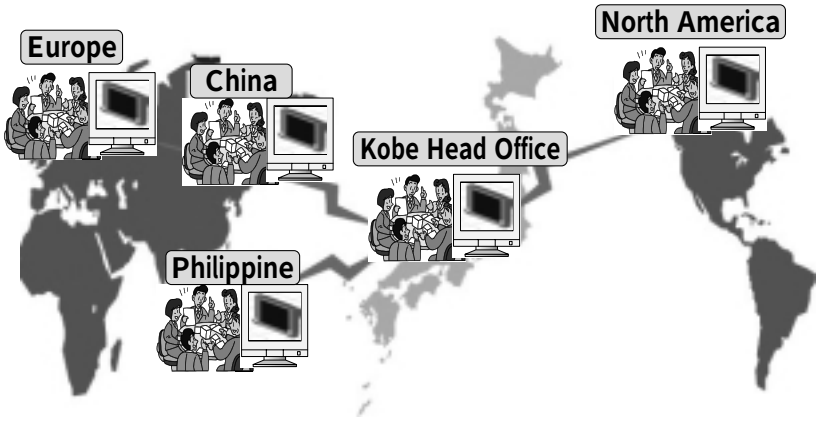

Abstract

FUJITSU TEN GROUP has established subsidiary companies overseas as a design center for efficiency of design/development, and has been conducting the global design that means the design departments of FUJITSU TEN (Kobe Head Office) and the overseas design centers work cooperatively.

FUJITSU TEN GROUP aims to entrust design to the overseas design centers. The current form is the collaborative design that FUJITSU TEN (Kobe Head Office) and the overseas design centers divide the design requirements of the same product. In the future, we plan to shift to 24-hours design using the time difference between Japan and the sites abroad.

The tasks for establishment of global design environment included network environment, maintenance of common environment, sharing of information during designing, communication with remote locations, and achieving satisfactory compliance. We introduce the application of SBC technology, the management system of three-dimensional CAD data, and the remote collaboration system that solved the tasks above mentioned in the course of establishing the design environment, and also introduce their achievement.

1 Introduction

With the increase in product development in recent years, the better efficiency in development/design is required. In response, FUJITSU TEN GROUP has established overseas subsidiaries as design centers and utilizes the resources. Global design means that the overseas design centers and the design departments of FUJITSU TEN (Kobe Head Office) work cooperatively. In this article, we explain the establishment of environment for systems, tools, operating rules and so on in order to conduct the global design.

2 Form and Tasks of Global Design

FUJITSU TEN GROUP has more than a dozen overseas subsidiaries as related companies. Of these, design centers that conduct the development/design work of products are shown in Table 1.

Table 1 FUJITSU TEN GROUP Overseas Design Centers

Name of subsidiary companies	Location	Engineer
FUJITSU TEN (EUROPE) GmbH	Germany (Nürnberg)	20
FUJITSU TEN TECHNICAL CENTER, USA, INC.	America (Michigan)	35
FUJITSU TEN RESEARCH & DEVELOPMENT (TIANJIN) LTD.	China (Tianjin)	181
FUJITSU TEN SOLUTIONS PHILIPPINES,INC.	Philippine (Manila)	301

In this section, we mention the following two points:

- The form and a workflow of the global design for which FUJITSU TEN GROUP aims
- Tasks for the establishment of our global design environment

2.1 Form and Workflow of the Global Design for which FUJITSU TEN GROUP Aims

In the global deployment of FUJITSU TEN GROUP, FUJITSU TEN (Kobe Head Office) controls and instructs the overseas subsidiaries in each country and each function. Therefore, the form of the global design for which FUJITSU TEN GROUP aims is as follows:

- FUJITSU TEN (Kobe Head Office) entrusts the design to the overseas design centers.
- Design departments of FUJITSU TEN (Kobe Head Office) take responsibility for the design.
- Design products such as drawings belong to FUJITSU TEN (Kobe Head Office).

Furthermore, as for the division in the design entrustment, FUJITSU TEN GROUP conducts individual design (A) and collaborative design (B) using the following three methods.

A. Individual design: Divided by the product type or individual model
B. Collaborative design: Dividing the design of the same product by the units or parts comprising the product
C. 24-hours design: Dividing the design of the same product/parts by time using the time differences between the overseas design centers

In the future, we plan to shift to 24-hours design as each design center grows.

The workflow of the current global design is as follows (Figure 1):

①FUJITSU TEN (Kobe Head Office) provides the design specifications to the overseas design centers.
②The overseas design centers conduct the design/drafting/inspection based on the design specifications.
③Conduct the required design review between FUJITSU TEN (Kobe Head Office) and the overseas design centers.
④The overseas design centers deliver the drawings or CAD data and others as the design products to FUJITSU TEN (Kobe Head Office).
⑤FUJITSU TEN (Kobe Head Office) approves the drawings or CAD data delivered by the overseas design centers.

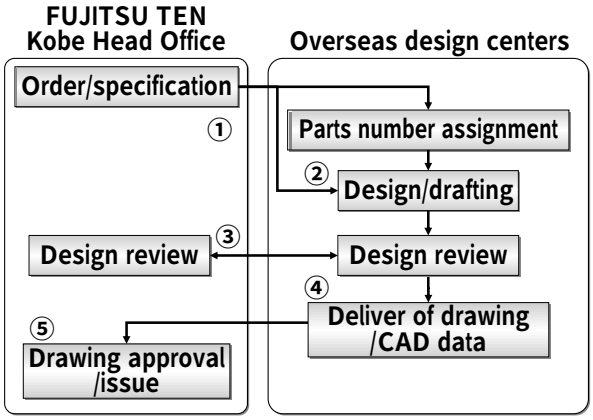

Fig.1 Workflow of Global Design

2.2 Tasks for Establishment of Global Design Environment

The tasks to establish the global design environment are as follows.

2.2.1 Network Environment

FUJITSU TEN GROUP and the overseas design centers are connected to each other by intranet, however its network bandwidth is 1/100 of that of FUJITSU TEN (Kobe Head Office). If existing systems or tools of FUJITSU TEN (Kobe Head Office) are used directly, or large amount of data is transferred, the following two problems arise.

①The work cannot be begun due to the degradation of response of the existing systems and tools.
②Another communication is disturbed and the operation is stopped.

If the bandwidth is increased to as much as that of FUJITSU TEN (Kobe Head Office), a large budget for the line and the facility is required. Therefore, there is a task of ensuring the stable response of the required systems and tools in the existing network environment.

2.2.2 Maintenance of Common Environment

The overseas design centers need various types of tools such as CAD and others to conduct the design

work. FUJITSU TEN (Kobe Head Office) inspects, approves, and utilizes the delivered drawing data and others and therefore environment of tools must be always common. Therefore, there is a task of efficient maintenance and preservation of the tool environment of the overseas design centers.

2.2.3 Sharing of Information during Designing

The overseas design centers and FUJITSU TEN (Kobe Head Office) need to share the drawings, CAD data or various types of technical information during designing to conduct the collaborative design. In particular, when using 3D CAD, the tasks are as follows:

①Easily fulfilling the access control or mutual exclusion of many CAD data comprising hierarchic structure

②Transferring or manipulating the huge 3D CAD data in the existing network environment with a good response

2.2.4 Communication with Remote Locations

In design/drafting review, the latest drawings or CAD data are referred at the same time and communicate based on that, and the drawings and CAD data are modified on the spot. The existing means such as FAX, telephone, E-mail and teleconference have problems such as uncertainty and inefficiency. Therefore, there is a task of improving the quality and efficiency of communication with remote locations.

2.2.5 Satisfaction of Compliance

When providing information to the overseas design centers, there are the following two restrictions:

①Information about products that is subject to regulation of export control cannot be disclosed to overseas.

②Information cannot be disclosed to unauthorized persons from the standpoint of leakage prevention of customer information, and information security such as security control and so forth.

Therefore, there is a task of narrowing disclosure of information that can be provided only to an authorized person.

3 Case of Establishment of Global Design Environment

The entrustment of design to the overseas design centers has altered in the following three steps with the improvement of the design technology level of the overseas design centers. (Figure 2)

First step: The overseas design centers can conduct design/drafting.

Second step: The overseas design centers can conduct the design work equivalent to FUJITSU TEN (Kobe Head Office).

Third step (Current condition):
The overseas design centers and FUJITSU TEN (Kobe Head Office) can conduct the collaborative design together, sharing drawings and others during designing.

FUJITSU TEN GROUP has overcome the tasks aforementioned by each step, and has established the design environment maintaining and providing the required systems or tools. Figure 3 shows the flow of the current global design, and main systems and tools comprising the design environment. In the process of establishing the design environment, we have solved the tasks aforementioned sequentially. The main items are shown in Table 2.

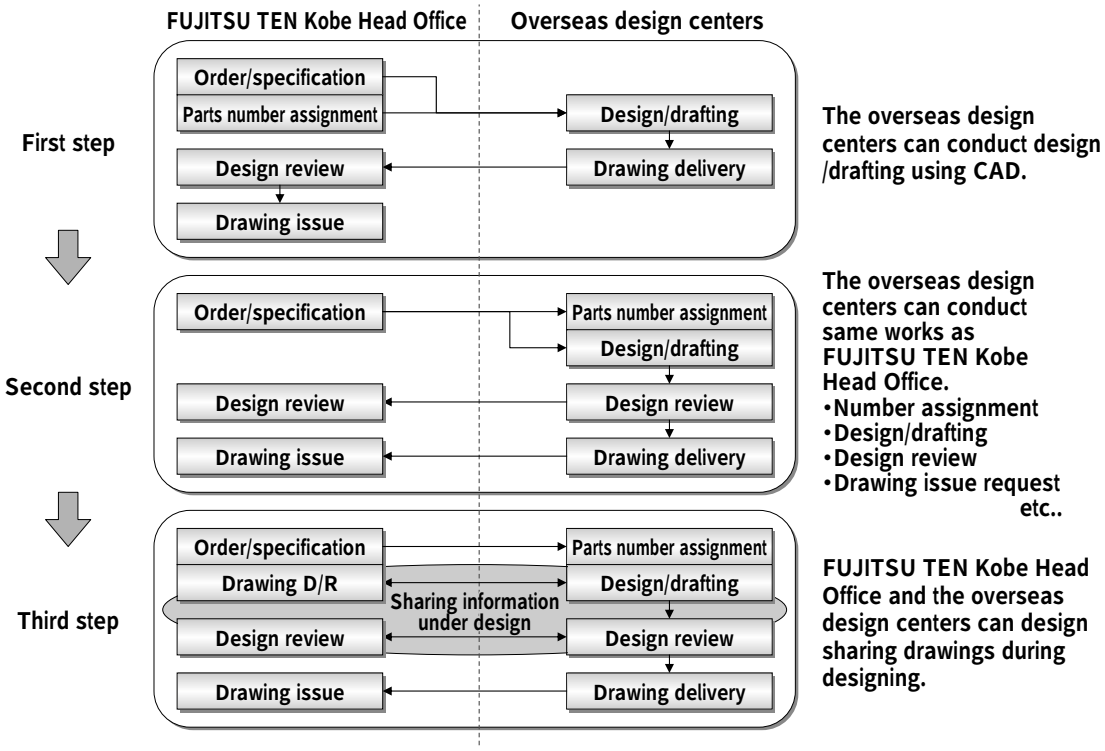

Fig.2 Alteration of Global Design

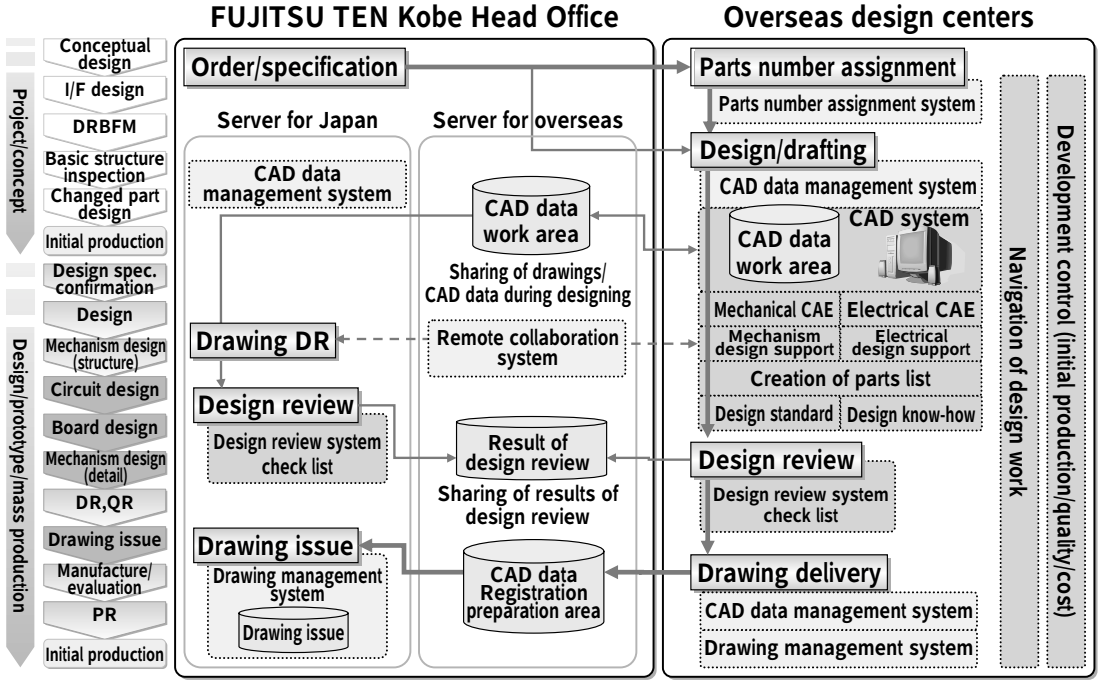

Fig.3 Flow and Development Support Tool System of Global Design

Table 2 Tasks and Measures for Establishment of Global Design Environment

Tasks			Measures
Establishment step (Design level of sites)	First step	Local procurement of CAD tool	Utilization of local vendor
		Maintenance of CAD environment	Automatic update of library
			Software for remote operation
	Second step	Provision of the existing system (Network environment)	Application of SBC technology
	Third step	Share management of CAD data (Access/exclusion control)	Management system of 3D data (CDM)
		Response/influence when transferring CAD data	Management system of 3D data (CDM custom function)
		Accurate and effective communication	Remote collaboration system (WebDR)
Achieving satisfactory compliance		Regulation of export control	Restriction on information disclosure for each part number
		Information security	Interaction with SSO (Reference restriction)

SBC: Server Based Computing
SSO: Single Sign On

First of all, we give a detailed description of the following three items as specific examples of tools and systems. (Yellow area in Figure 3)

- Parts number assignment/drawing management system
- Management system of 3D CAD data
- Remote collaboration system

Then, we explain our approach to the achieving satisfactory compliance.

3.1 Parts Number Assignment/Drawing Management System

We explain the application of Server Based Computing (hereinafter referred to as SBC) technology to parts number assignment/drawing management system as a case of provision of the existing system to the overseas design centers in the second step.

The parts number assignment/drawing management system utilized in Japan had been provided by client server (hereinafter referred to as C/S) and therefore the systems cannot be provided by the network line with the overseas design centers. (Figure 5)

We decided to change the provision form and aimed for the following three points:

- Ensuring the operation response equivalent to that in Japan
- Ensuring the operability equivalent to C/S
- Avoiding the system duplexing, and restraining the man-hours required for development/maintenance and system failure

At first, we established the web version of the system, however we could not obtain a good enough result.

Next, we considered the application of solution, SBC, this is so-called thin client technology.

The principle of SBC is shown in Figure 4. The application is run in a virtual environment of a server created for each user, and only differentiated information on its screen is sent to the client terminal. From the client, keyboard input information and mouse information are sent to SBC server, and the application is operated. The users can operate the application as if C/S system runs.

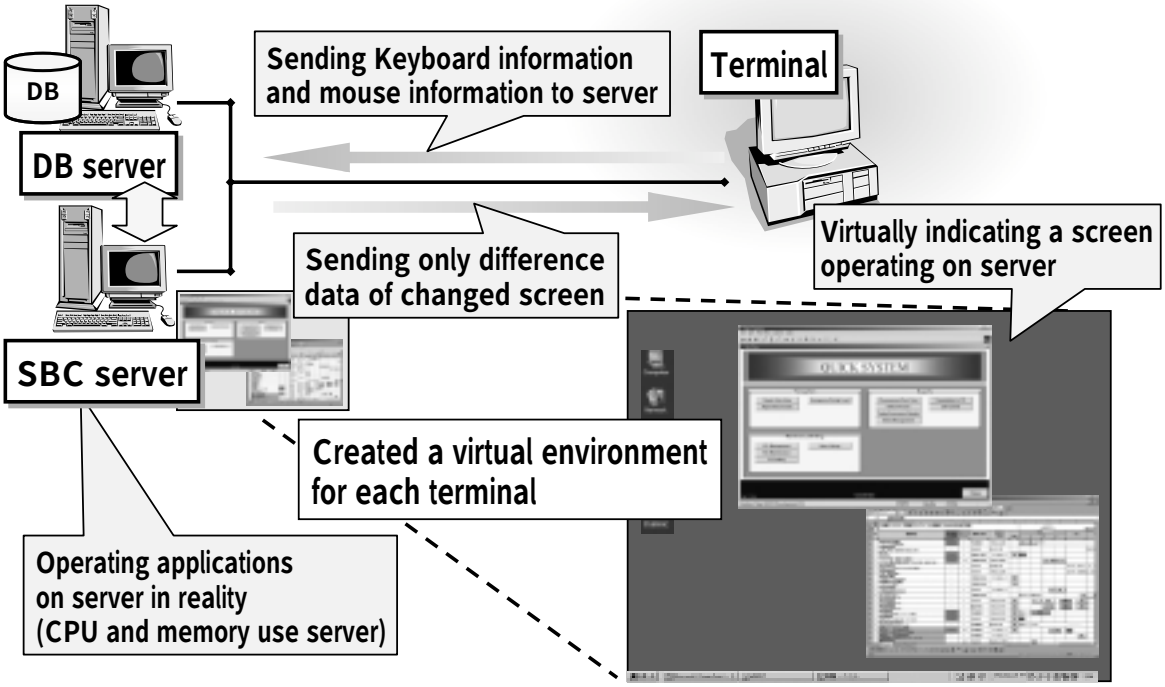

Fig.4 Principle of SBC

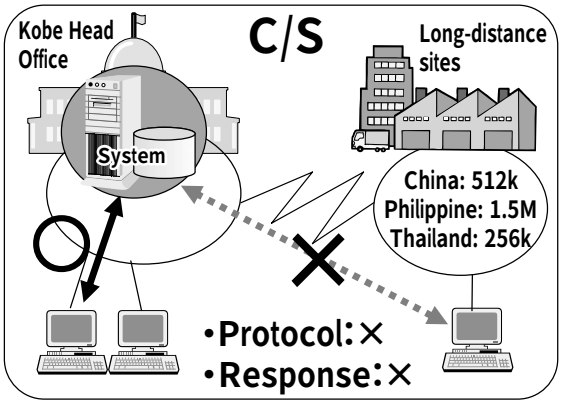

Fig.5 System Image of C/S

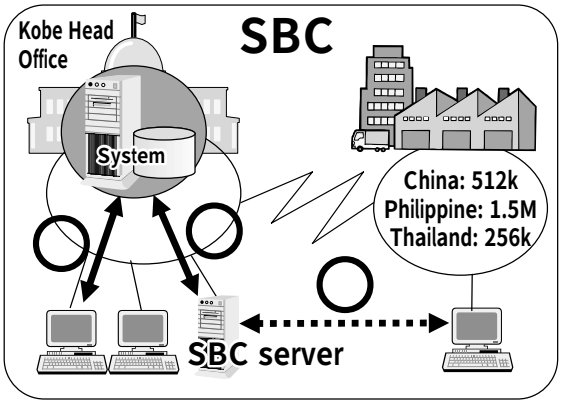

Fig.6 System Image after SBC applied

Also, the server resource is used as hardware resource (CPU, memory, and HDD) and therefore the operation is unaffected by the terminal performance. The users can use the application with the stable response.

The advantages of SBC technology are as follows:

- Applications can be used by even narrowband LAN with a stable response.
- System can be used without depending on OS of the terminal.
- Terminal software setting is not necessary.
- Failures attributed to the terminal can be depleted.

By applying this SBC technology, the parts number assignment/drawing management system can be used in the overseas design centers with the same response as in Japan if there is LAN environment of at least 512kbps. (Table 3) This makes possible a series of design work from part number assignment to delivery of drawing/CAD data in the overseas design centers.

Table 3 Difference of System Response between C/S and SBC

C/S			SBC			
	KOBE Head Office	Long-distance sites	128k	256k	512k	1.5M
Start-up screen	3 sec.	Impossible	10 sec.	8 sec.	6 sec.	4 sec.
Other screen	1 sec.	Impossible	5 sec.	3 sec.	1 sec.	1 sec.

3.2 Data Management in 3D Design

As a case of sharing information during designing, we explain the following two points for 3D CAD data management.

- System introduction for the basic data management
- Extension of dispersion management function for sharing the huge data

3.2.1 Introduction of 3D Data Management System

The following three points are the main requirements for 3D CAD data management:

①3D CAD data forms multiple parts comprising a product, having a concept of hierarchy and therefore this construction information should be managed easily.

②FUJITSU TEN GROUP uses different 3D CAD software for the panel design and structure design respectively and therefore these multiple CAD data should be managed collectively by one system.

③FUJITSU TEN (Kobe Head Office) and the overseas design centers conduct the collaborative design and therefore CAD data should be shared controlling access or exclusion.

We introduced Fujitsu Concurrent Design Manager (hereinafter referred to as CDM) in order to meet these requirements, and decided to manage 3D CAD data at multiple overseas design centers.

The advantages flowing from using the function of CDM introduced this time are as follows:

- The product structure is indicated by tree view and its details can be grasped visually. Therefore, designers can easily find the CAD data they need. (Figure 7)
- Multiple CAD data that FUJITSU TEN GROUP uses can be consolidated.
- Exclusive right of access or mutual exclusion can be set for each file and therefore CAD data can be managed easily when the multiple designers conduct simultaneous design such as group design and others.

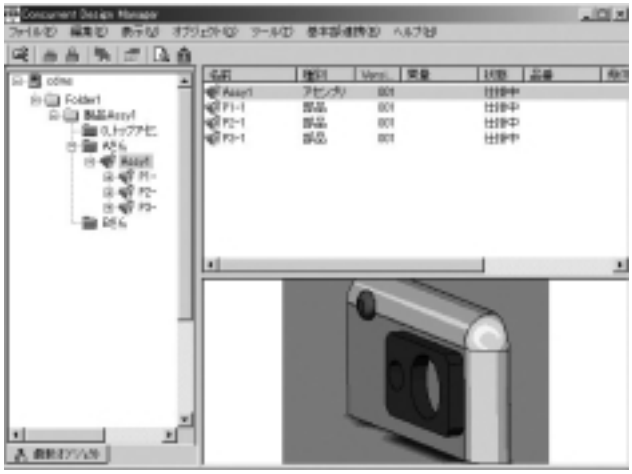

Fig.7 Screen Image of CDM

3.2.2 Functionality Extension of System

Under the small network between FUJITSU TEN (Kobe Head Office) and the overseas design centers, if the overseas design centers directly refer the huge 3D CAD data of FUJITSU TEN (Kobe Head Office), not only does the operation response at the overseas design centers get worse but also other communication may be adversely affected.

For example, if the line of 512kbps is occupied entirely in order to transfer about 100MB 3D CAD data, it takes more than 30 minutes to complete the transfer. During the transfer, other system communication may be affected and the operation may be stopped.

Consequently, in order to minimize the frequency of 3D CAD data transfer between FUJITSU TEN (Kobe Head Office) and the overseas design centers, we customized the CDM data dispersion management function and extended the function as follows:

- Set the server for storing CAD data in FUJITSU TEN (Kobe Head Office) and each overseas design center, and for daily design work, refer to CAD data stored at each overseas design center.
- Consolidate whereabouts of CAD data and user management information in the server of FUJITSU TEN (Kobe Head Office), and control to which data of design center each user refers.
- Define four processes of data transfer so that they correspond to the workflow of the design entrustment, and transfer CAD data and shift the exclusive right in each process. (Table 4)
- Cooperate with existing PDM system, and move CAD data in conjunction with drawing release/approval process of PDM system when delivery process.

The image of this functionality extension is shown in Figure 8.

Table 4 Types of Data Transfer

Lending	Transfer CAD data possessed by Japan to which read-only/editable authority is given in order to use at overseas design centers.
Delivery	Transfer CAD data to Japan, which is designed/edited at the overseas design centers.
Synchronous	Match both data if there is a difference of CAD data between Japan and the overseas design centers.
Repossession	Mandatorily repossess CAD data transferred to the overseas design centers.

The advantages of this functionality extension are as follows:

- Daily 3D design work can be conducted with the stable response at any overseas design centers.
- CAD data can be synchronized and shared easily when design review and confirmation are required between FUJITSU TEN (Kobe Head Office) and the overseas design centers.

We achieved the management/sharing of 3D CAD data by customization adding the workflow for the collaborative design conducted by the overseas design centers and FUJITSU TEN (Kobe Head Office), in addition to the basic function of CDM as mentioned above.

This has enabled FUJITSU TEN (Kobe Head Office) and the overseas design centers to conduct the collaborative design sharing the latest CAD data.

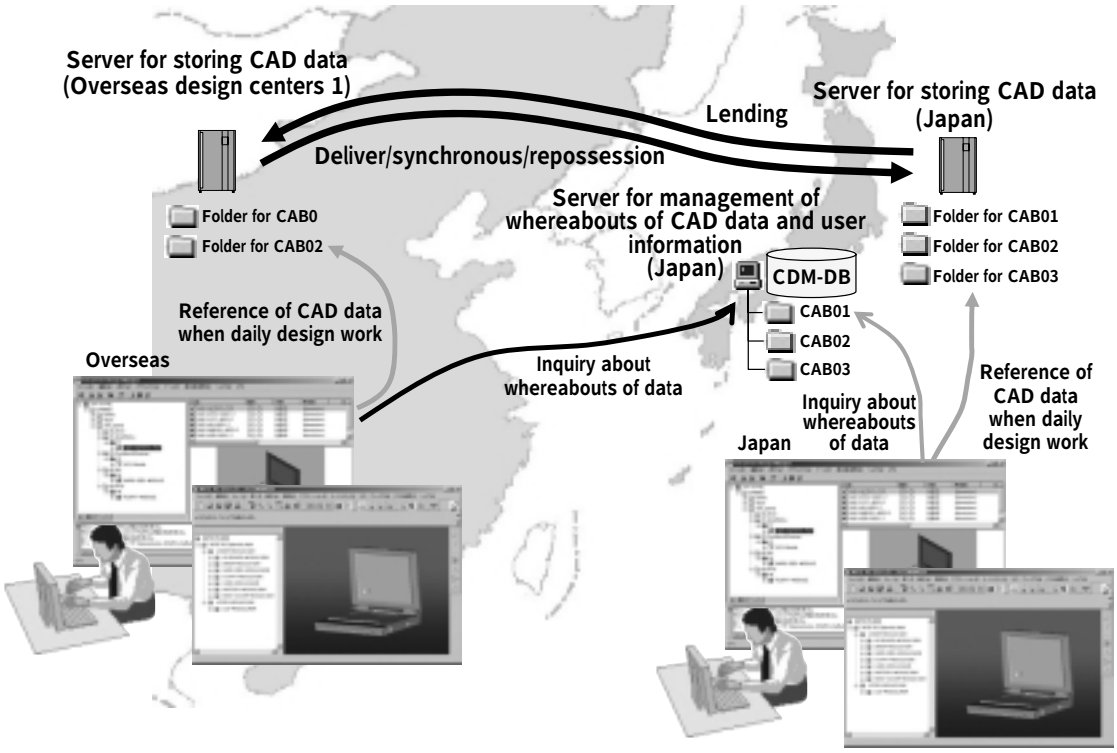

Fig.8 Data Dispersion Management by CDM

3.3 Remote Collaboration System

We explain the remote collaboration system as an example of real-time communication tool with the overseas design centers.

As mentioned previously, in the review with the overseas design centers, we depended on the design instruction by FAX of drawings, telephone, E-mail, and teleconference.

However, these methods have the following problems and they interfered with the improvement of design efficiency/design quality.

- Man-hour for preparation in advance such as an output of FAX of drawings is needed.
- FAX can use up to A3 paper only and therefore it is difficult to read the detail of the drawing.
- Teleconference needs a reservation of place and time and therefore flexible action cannot be taken.
- Instruction by telephone/E-mail creates mistakes and misunderstandings with speculation.

Consequently, we newly established the remote collaboration system and provided it in order to improve the quality and efficiency of communication, making real-time communication with the overseas design centers.

This system is that a computer screen and a web camera image between remote locations are shared by the network, and the main functions are following three points:

- Teleconference function (video and voice)
- Application sharing function (screen sharing and interoperation)
- Chat and whiteboard function

In addition to the above, we established a system emphasizing the following four points:

①3D CAD can be operated and used as a sharing application.
②Communication security can be ensured sufficiently.
③Preparation and procedure of the system before use are easy, and it can be used anytime and anywhere.
④The system can be used by many people at the same time.

For system establishment, the following customization was made based on "IC^{3}"※1.

- Coordinated the system login with the existing in-house Single Sign On (hereinafter referred to as SSO) in order to consolidate the users.
- Set the system in FUJITSU TEN GROUP extranet in order to use the system from outside the company, and cooperated with security control by VPN technology.

The utilization image is shown in Figure 9. This system is deployed as "WebDR" in FUJITSU TEN GROUP.

As a feature of this system, an office computer connected to in-house network can use the system anytime and anywhere without special software if the computer can use web browser.

※1 "IC^{3}": Web-meeting system of Canon Software Information System Inc.

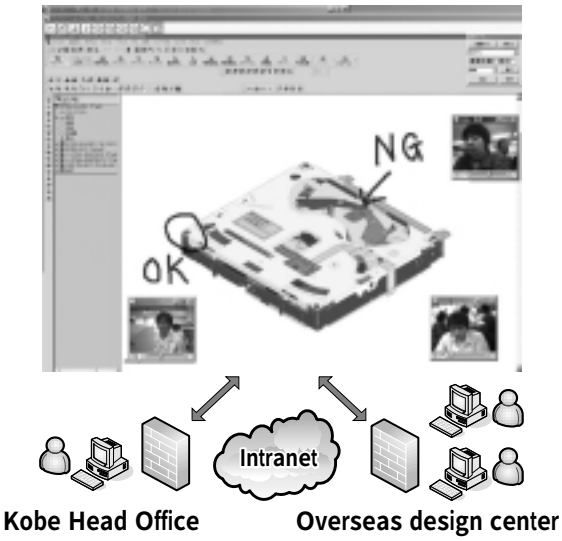

Fig.9 Utilization Image of Remote Collaboration System

The advantages of "WebDR" are the following four points.

- Operation and communication by watching the same screen, face to face have reduced the misunderstandings and have improved the design quality.
- Results can be reflected on the drawings or 3D CAD on the spot because "WebDR" can be used in real-time.
- Man-hours have been reduced because the time for advance preparation is saved.
  (Example: Reduced about eight hours to check the problems of one model.)
- Communication cost has been reduced because the use of a telephone/FAX is reduced.

At first, "WebDR" had been used in design departments only, however other departments requested to use the system. Now marketing & sales department and quality assurance department can use the system. Also, the system is used at meeting with customers and suppliers as a tool ensuring security.

3.4 Response to Achieving Satisfactory Compliance

We took two measures with the system in order to provide and disclose the information, which can be provided, to the overseas design centers.

(1) Restriction on information disclosure by parts number

Applicability judgment information by the parts number for regulation on control of exports and the system have been incorporated, and the drawings of the applicable products have not been disclosed.

(2) Prevention of information leakage and enhancement of information security

Authority of users for system utilization and information reference is restricted by cooperating each tool and system with SSO system commonly used in-house, and the security has been enhanced so that unnecessary person cannot utilize unnecessary system or information.

(Details are omitted here for reasons of confidentiality.)

4 Conclusion

We have explained the recently introduced FUJITSU TEN GROUP global design environment.

This enables FUJITSU TEN (Kobe Head Office) and the overseas design centers to conduct collaborative design work together, and the efficiency of the design is improved utilizing resource of the overseas design centers.

The achievements are as follows:

- Improvement of design efficiency and design quality at the overseas design centers
- Improvement of design quality of overseas due to the improvement of quality and efficiency of communication between FUJITSU TEN (Kobe Head Office) and the overseas design centers
- Control of fixed cost due to avoidance of investment in the network environment

In the future, we will strengthen the following efforts in order to respond to simultaneous design and 24-hours design at multiple overseas design centers.

- Maintenance and deployment of the design tool and system suitable for simultaneous design
- Development and provision of tools that enable sharing information of progress of design at multiple sites
- Project and establishment of a contrivance that enables collection and sharing of design know-how information at each overseas design center

We will seek better efficiency of the design and improvement of its quality, and will provide attractive products to our customers.

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