Development of Production Management System Based on Open System Technology for Large Diameter Pipe

by
Hiromitsu Kase / Kashima System Planning Dept., System Div.
Mitsuru Watanabe / Pipe & Shape Dept., Kashima Steel Works

Synopsis

The newly developed computer system for production management in a large diameter steel pipe plant began operation in February, 1996. This new system has been developed based on open system technology, and reduces the size of the mainframe computer. Several functions of this system have been enhanced to improve the customer satisfaction; the traceability of pipe quality, the quick delivery of pipe information, and so on. This report introduces the new system, VENUS (= Valuable Engineering New UOE System).

1. Introduction

Large diameter steel pipe is used mainly in oil and natural gas pipelines. The requirement for pipe quality is becoming stricter year by year for safety and reliability on these pipelines. Especially, full traceability of pipe quality from the steel source to the final product pipe is required. Additionally, there is a variety of information concerning pipe quality in terms of range and amount of detail, and some customers also require some kinds of inspection results for pipes very quickly.

On the other hand, in the computer market, the cost of personal computers and workstations are coming down day by day, and open system technology is growing due to larger scale systems being built.

In order to meet customer requirements and to prepare to expand the system in the future, we decided to develop a new production management system based on open system technology, because an open system is cheaper than a mainframe computer system in the long run and it is possible to extend it flexibly according to customer requirements.

This paper introduces how the system was developed, the configuration, some features, and the effects of this system.

2. Configuration of System

The previous production management system for large diameter pipe was run on a mainframe computer that contained three other production management systems, for steel making processes, for thick plate and for logistics in the steel works. This mainframe computer will be replaced in the near future. Therefore, the system for large diameter pipe has been reduced in size to a client/server system because we want to reduce long term costs and ensure flexible extensibility (**Fig. 1**).

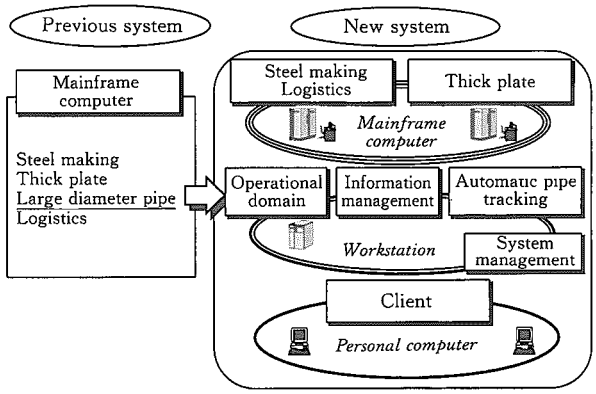

Fig. 1 Size reduction

This newly developed system consists of two workstation (Operation System(OS):Unix) servers and about one hundred personal computer (OS:Windows) clients. One server is the operation domain server which manages production, i.e., production schedule, instructions for manufacturing and controlling pipe quality, and so on. The other is the information managing server which has a database prepared for End User Computing. In addition, this system has two more workstations. One is an automatic pipe tracking workstation which gathers process data in the plant in real-time, and the other is a system management workstation which backs up the servers' databases and distributes and installs application programs to the clients. These workstations and personal computers are connected on an Ethernet LAN (Local Area Network) (**Fig. 2**).

3. Feature of System

3.1 Piece Tracking System

The large diameter pipe manufacturing process consists of four main stages: Forming, Welding, Expanding, and Inspection (**Fig. 3**). After being given edge preparation, steel plate passes through three kinds of presses and is formed into a round shell. Then, it goes through tack welding and internal and external welding, and becomes a pipe. Next, the weld portion and pipe surface are inspected. When defects are delected, the pipe goes back to the previous process and is repaired and inspected in detail.

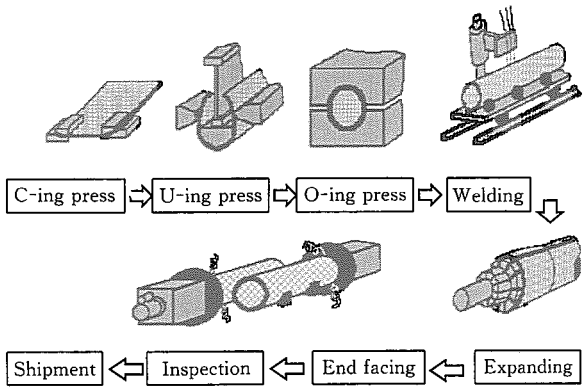

Fig. 2 Configuration of system

The piece tracking system has divided the manufacturing process into 180 tracking zones and has made it possible to automatically track about 300 pipes being processed in this plant, and also carry them to the next process according to inspection results. In addition, this system collects data on the actual manufacturing condition and quality of each pipe automatically and/or manually.[1),2)]

3.2 Open System Technology

The production management system is required to assure and control data communications with clients and other systems. In order to solve this problem, we use two types of software: an on-line transaction process monitor (OLTP) and a relational database management system (RDBMS) (**Fig. 4**).

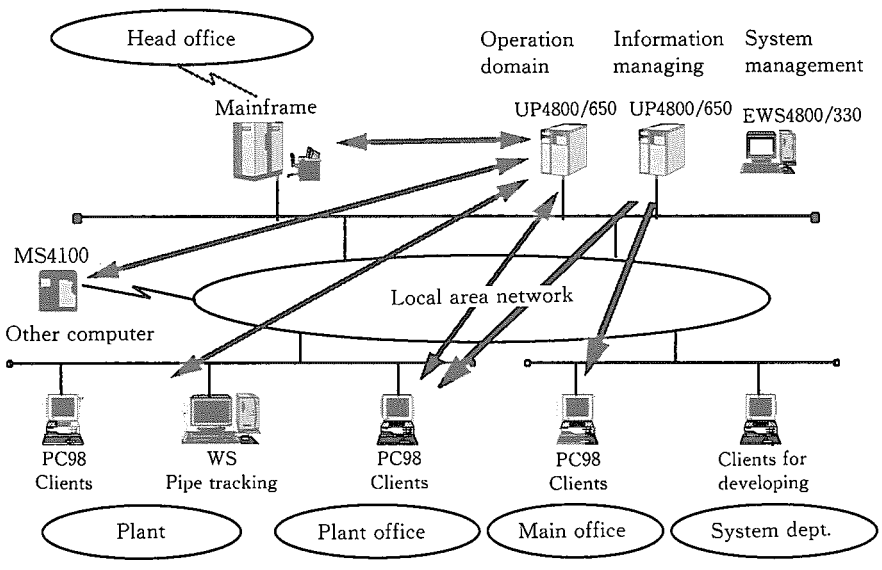

Fig. 3 Manufacturing process

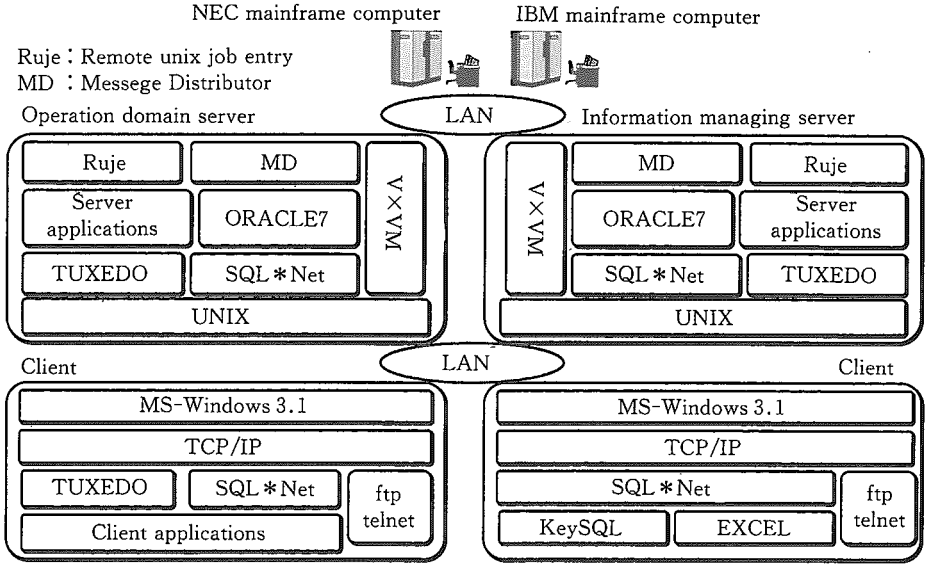

Fig. 4 Configuration of software

As OLTP software, we use TUXEDO because it's based on an international standard model and has many useful functions, for example two-phase commit transaction and recovery. TUXEDO can assure the transaction of on-line server processes and decreases network traffic between server processing and client processing (**Fig. 5**).

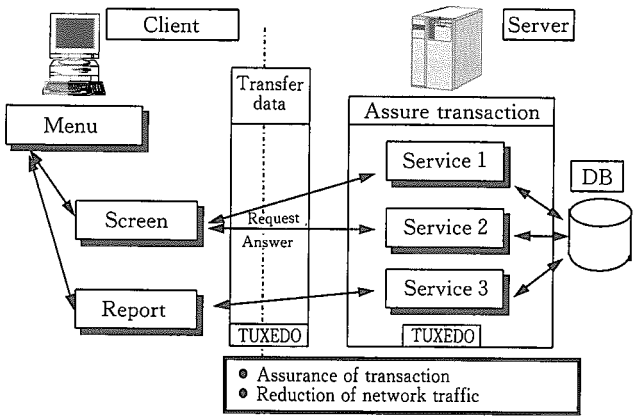

Fig. 5 Function of TUXEDO

As RDBMS software, we chose ORACLE7 Server because it's the most widely used in the world and has the most effective data assurance capabilities, for example, on-line back-up and recovery.

And, we use HOLON/AB as the application developing tool. It's a visually oriented program and provides a graphical user interface (GUI) which makes it possible to input manually without code dictionaries. Moreover, it makes possible development of server application programs on client personal computers. We adopted a prototyping method and are getting higher application programming productivity as a result.

3.3 Continuously Running 24 Hours a Day

The production management of a large diameter pipe steel plant must be run continuously 24 hours a day. If the system stops, production of the plant is forced to stop and a lot of money is lost. Therefore, we add special attention to problems which might stop the system running, for example, server hardware breakdown.

This newly developed system consists of two server machines, and they are of the same type. They monitor each other all the time. The information managing server has another role as a substitute for the operation domain server. If the operation domain server goes down because of some problem, the information managing server automatically takes over its functions and database. Additionally, the database of the operation domain server is mirrored in order to prevent it from stopping as a result of hardware disk defects.(**Fig. 6**)

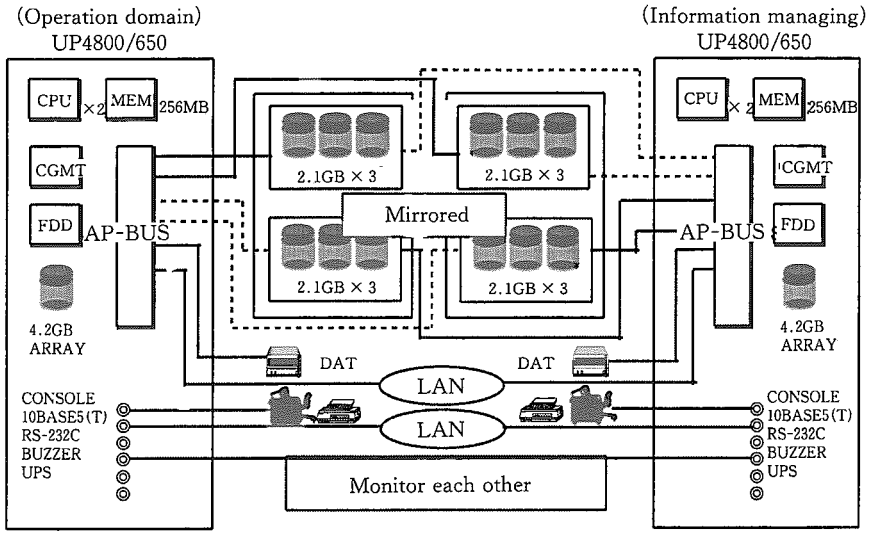

Fig. 6 Configuration of servers hardware

3.4 End User Computing

The information managing server has a database (DB) for end user computing. End user means operators and staff of the large diameter pipe plant. The DB has two types of data. One is a short term storage DB which contains data of pipe being produced now. This DB is updated by the replication technology in ORACLE7 Server at the same time as the operation domain server's DB is updated, so the end user can select data in real-time. The other is a long term storage DB which handles pipe data after shipment. This DB contains pipe data for up to three years, so that the end user can analyze long term trends. Both DB have table views with Japanese columns, that are accessed easily by the end user, who can only view and cannot alter it (**Fig. 7**).

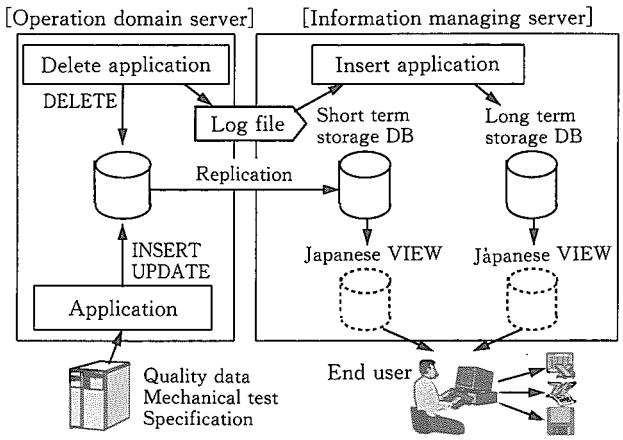

Fig. 7 End user computing

As the tool to select data, we use general software. The connection DB and data selecting is done by KeySQL, and the spreadsheet is done on EXCEL. KeySQL consists of a GUI interface, prepares a list of tables and columns, and is capable of generating Visual Basic Application (VBA) program sources. Some end users make programs with this VBA by themselves, which make it easier for them to do routine operations.

3.5 System Management

The system management workstation mainly plays the following three roles. It uses the maintenance software NetAdmin.

First, it distributes and installs application programs to about 100 clients. When we update any of the client programs, we only enter them on the system management server. They are distributed and installed to the clients personal computers automatically by NetAdmin (**Fig. 8**).

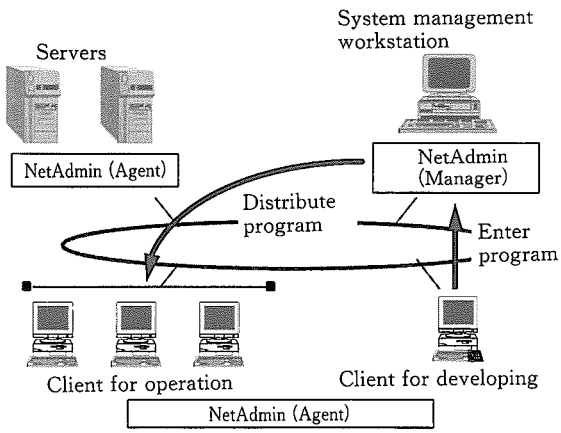

Fig. 8 Distribution of program

Second, it monitors both the two servers and personal computer clients all the time. If something happens, for example, an error in the server's hardware or a batch program abort, the system management workstation immediately informs the system operator who manages all computer systems in the steel works. After that, he responds to that problem.

Third, it backs up the servers' databases on external media once a day. Its function is scheduled for two years. If a server's database should crash, we can restore the database from a recent copy kept on the external media.

4. Effects of System

This newly developed system has made it possible to trace pipe quality and has increased the kinds of data available.

So, quality information on pipe is managed and assured from the steel source to the final product pipe.

And, the system environment for end user computing has been created, so that the amount of time needed for routine operations and analyzing data is greatly reduced (**Fig. 9**). Consequently, customer requirements, such as the contents of mill certificates, can be prepared much sooner than before.

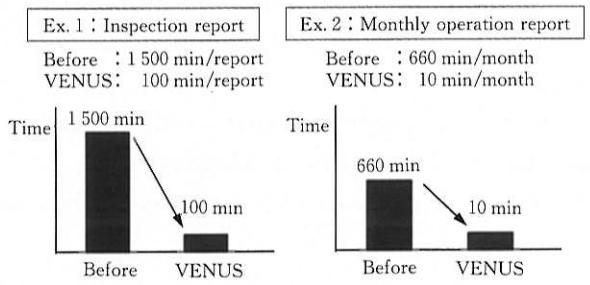

Fig. 9 Effect of end user computing

Overall, it is possible to respond to customer requirements quickly and flexibly, and as a result, customers are highly satisfied with our services, and order more pipes for large foreign pipeline projects.

5. Conclusion

We have developed a new production management system based on open system technology.

The main features of this system are as follows.

i) The quality of each pipe is traceable on a piece tracking system.

ii) The new system based on open system technology can be run with as much confidence as our previous mainframe computer.

iii) A system environment for end user computing was created, so end users can use the production and quality data easily.

As a result of the development of this new system, it's possible to trace pipe quality and to respond to customer requirements quickly.

We will apply open system technology to other production management systems in our steel works in the future.

Hiromitsu Kase

Kashima System Planning Dept., System Div.

Phone: 0299(84)2808

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2) K.Inoue and M.Soma : The Institute of Electrical Engineers of Japan, MID-97-4, IEA-97-4 (1997). p.17

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