

Mini-CIM, Distributed Processing System in CIM

Masaji Kawata
Tetsuo Kawata
Yoshinori Suizu

1. Introduction

Computer trends towards downsizing, open systems and the development of network technology are causing the system configuration to shift from centralized to distributed processing by personal computers and workstations.

FA personal computers and workstations are widely used in CIM integrated systems. The demand and requirement for distributed systems which use FA personal computers and workstations is expected to grow rapidly.

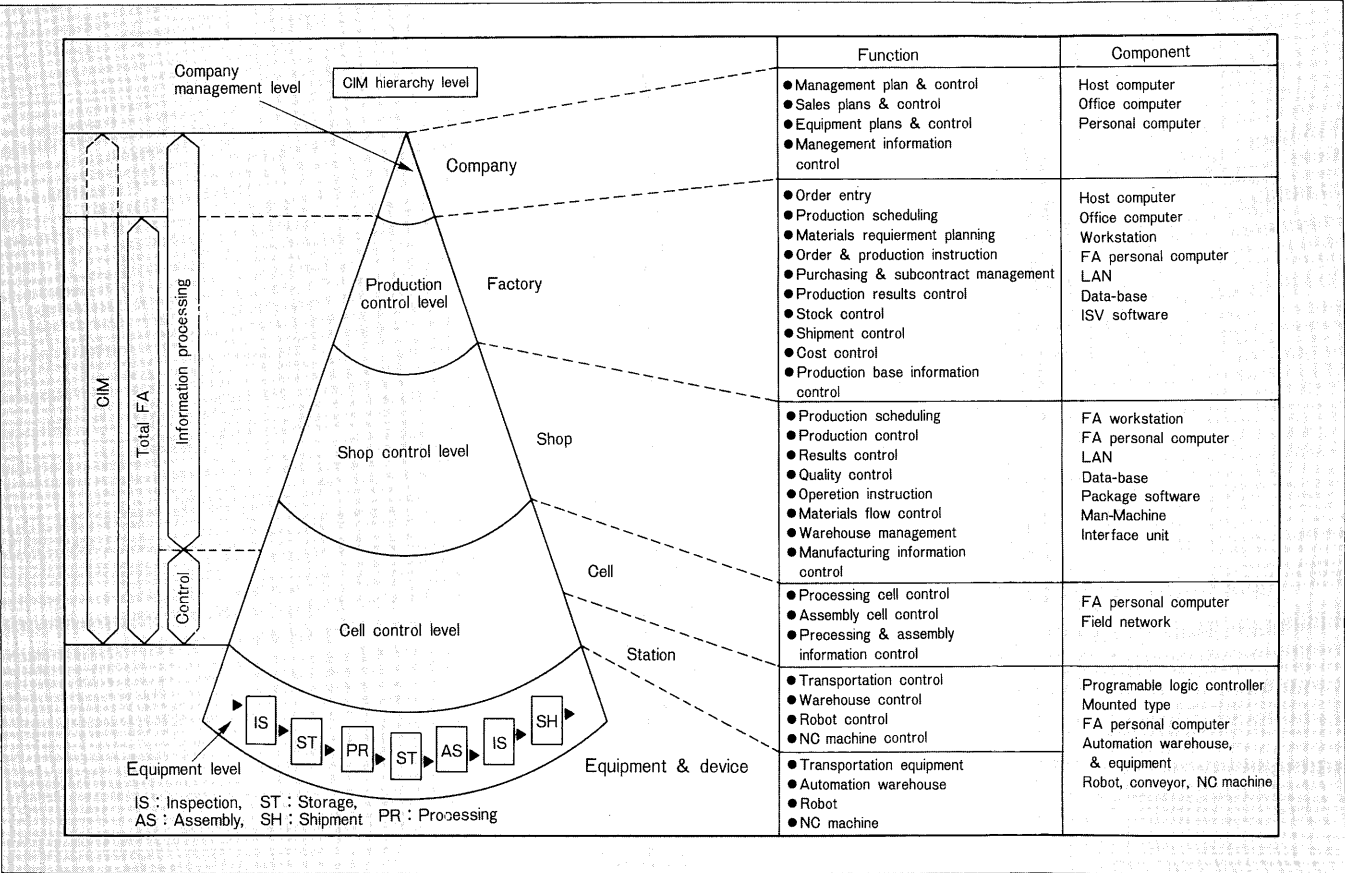
After introducing the concepts of CIM and Mini-CIM, Fuji Electric has gone on to develop CIM hardware and

software components and is supplying various computer systems, from office computers to FA personal computers and FA workstations, to many industries. This paper presents the concepts of Mini-CIM distributed systems using FA personal computers and workstations.

2. The Goal of Distributed Processing

Distributed processing system concepts have been routinely applied in the field of computer control systems. In this field, distributed processing concepts have proven to be effective to realize a reasonable distribution of functions and control risk dispersion.

Fig. 1 CIM hierarchy



Distributed processing systems are widely used in all types of computer systems, including those for business use, CIM and total FA use, etc. Below technical trends and user needs are presented and analyzed.

2.1 Technical trends

(1) Downsizing of computer systems

The processing power of personal computers, work stations, and other small computers has improved greatly. Jobs which used to require large scale host computers can be processed by personal computers and work stations.

(2) Network computing

Advances in networking technology are making it easier to link multiple computers and their various controllers together in order to share job processing responsibilities.

(3) Standardization of open systems

Multi-vendor CIM computer system integration is becoming easier with OS (UNIX*¹, OS/2*², etc.), LAN (Ethernet*³, MAP*⁴, NetWare*⁵, etc.), and application interface standardization.

(4) End user computing

With the widespread use of personal computers and the wide variety of package software, end users can easily configure computers systems for their particular need.

The four technical trends described above: downsizing, network computing, open systems, and end user computing, have made distributed processing systems possible.

2.2 User needs

Recently, CIM has become indispensable for medium

and small businesses. The ease of CIM installation is very important for users, **Figure 2** shows several problems for the installation of CIM and total FA integrated systems. Each individual business must resolve these problems. User needs can be summarized as the system components and integration technologies necessary so that:

- 1) end users, expert in their jobs, can configure a CIM system customized for their particular needs, without the assistance of computer system engineers;
- 2) the CIM system can be easily assembled in order, at low cost and in a short amount of time.

As one solution, CIM systems have been constructed from office computers and mini computers. However, these systems require system engineers, are expensive and lack flexibility. In many cases the problems referred to above are not adequately resolved. On the other hand, a CIM system constructed from inexpensive, easy to use FA workstations and FA personal computers with their full software package, results in systems which improve the efficiency of functions such as LAN, PLC (programmable logic controller) communication, etc., and continuous operation.

In the next section, the concepts of a Mini-CIM system using FA personal computers and FA workstations are presented.

3. Mini-CIM Concepts

The size of a CIM system depends on the particular industry and manufacturing scale, and can be large, medium or small. As expected, a large scale CIM system is a very complex system requiring the investment of considerable capital, time, technologies, and man power. User demands are for a CIM system, smaller than the medium and small scale systems, which may be realized in a short amount of time, is easy to construct and has low cost. Fuji Electric calls such a system "Mini-CIM".

The scale and size of Mini-CIM systems are shown in **Fig. 3**. Mini-CIM goals are listed below.

(1) Distributed processing system base

Change from centralized processing by one host computer to distributed processing throughout the different sections within a company.

(2) End user computing

Change from software development dependent on computer engineers to the development of application software by end users.

(3) Quick, easy and economical system construction

Step by step system construction.

(4) One line, real time processing base

Towards the integration of information processing systems and on site control systems.

Towards the synchronization of materials and information.

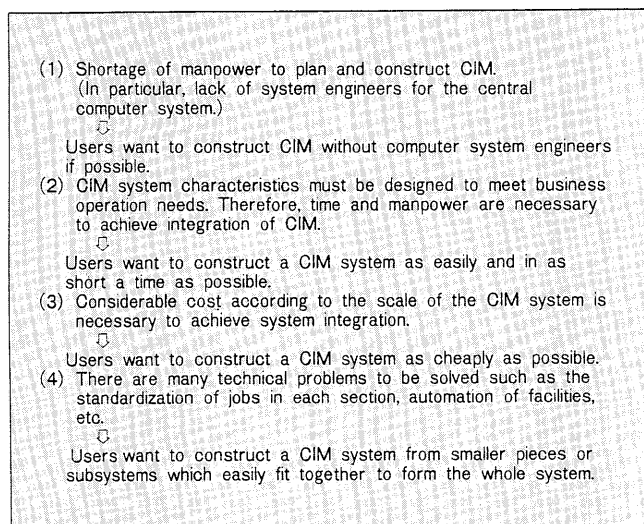
Change from batch processing to real time processing.

(5) Open systems

Change from single vendor to multi vendor solutions.

(6) Highly secure and reliable systems

Fig. 2 CIM related problems



To realize 24 hour continuous operation.

Based on the above goals, Fuji Electric continues to develop and enhance products for, and improve the function and performance of FA personal computers and FA workstations to meet CIM needs.

The construction of Mini-CIM systems will become easier with advances in hardware, software and network

technologies and through the cooperation of third parties developing products for open systems. Detailed system structure and function allotment is described below.

4. Mini-CIM Hierarchy and Distribution Concepts

4.1 Mini-CIM hierarchy

Mini-CIM can be divided into four processing levels as shown in Fig. 4: factory management level, shop control level, cell control level, and facility and equipment level. The highest level in an ordinary CIM system, the company management level, is excluded in a Mini-CIM system.

The factory management level is the highest level. Computer systems in this level are responsible for order receipt and shipment control, production planning and control, materials ordering and receiving and equipment maintenance, etc. There are no strong demands for simultaneous and real-time processing on this level.

The cell control level is directly connected to the production line. The flow of material and information between the equipment which constitute the line such as: NC (numerical control) machines, assembly machines, robots and an automated warehouse, is controlled in real-

Fig. 3 Scale of Mini-CIM system

- (1) Applicable to businesses which are relatively small scale. (Approximately 200 to 300 employees)
- (2) The entire system is relatively small scale and is composed of 20 to 30 personal computers or workstation systems.
- (3) Each section is relatively small. (2 to 3 personal computers/section)
- (4) The cost of a system can be inexpensive. (1,000,000 yen to 5,000,000 yen/system)
- (5) The required level of technology and manpower (computer engineers) can be minimal.
The level of technology of a personal computer system and the related knowledge is sufficient.
- (6) Easy to operate.

Fig. 4 Relation between each section and Mini-CIM hierarchy

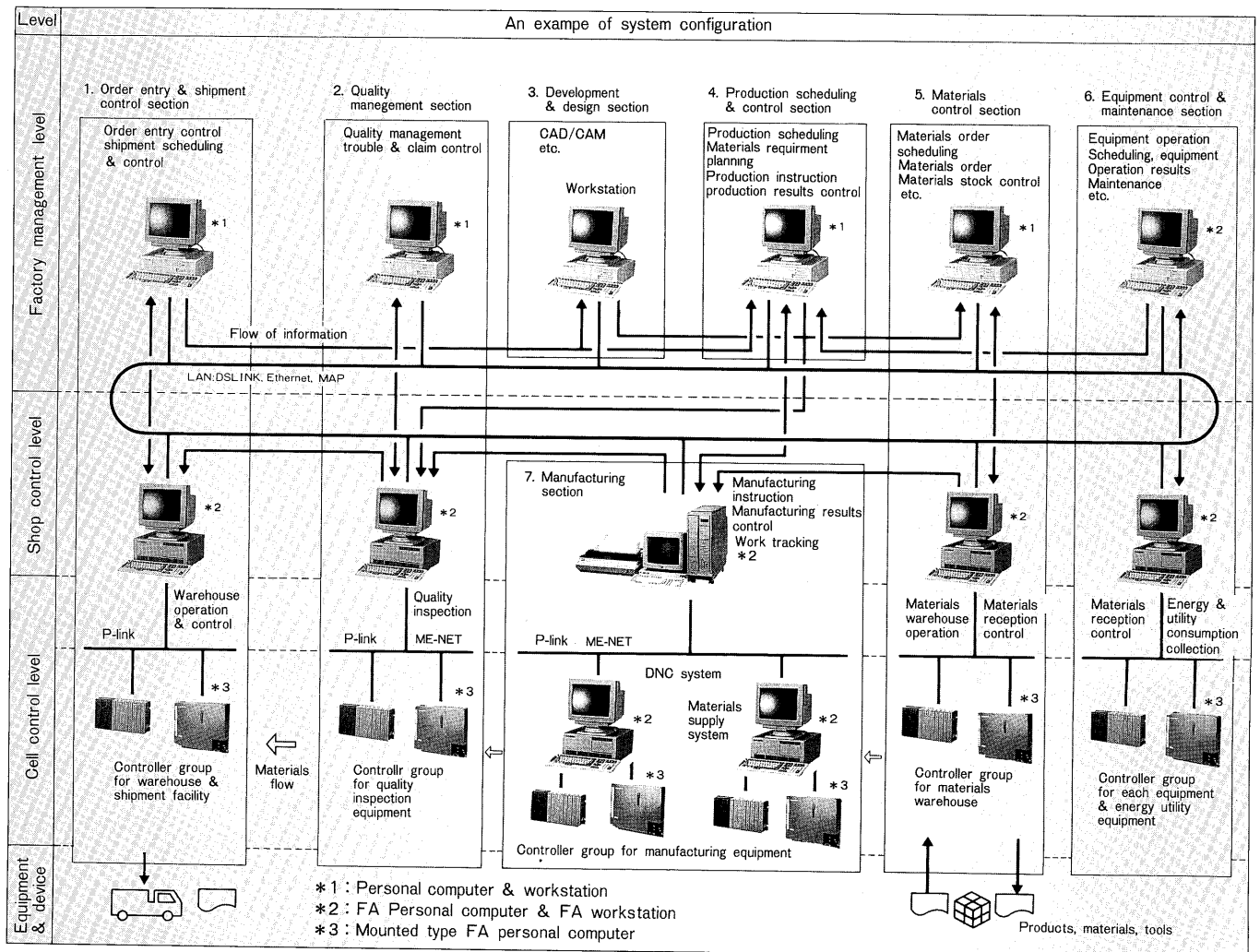
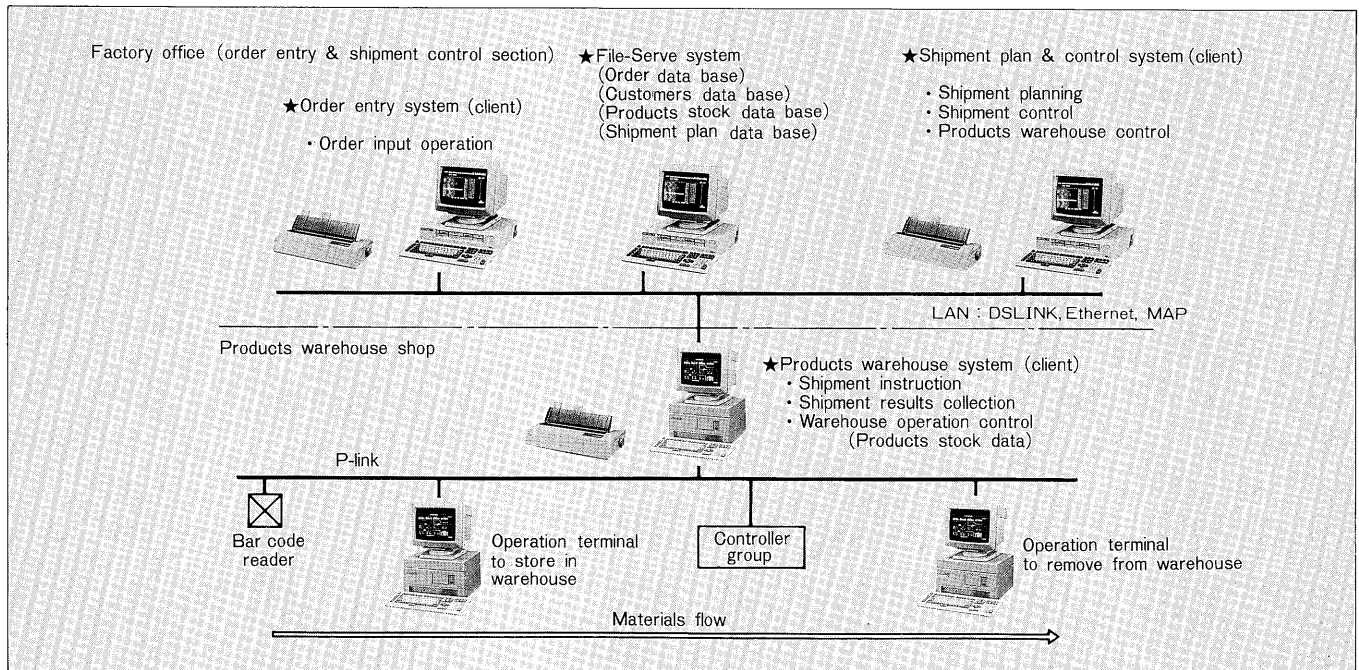


Fig. 5 An example distributed processing system in the order entry and shipment control section



time by cell controllers. It is in this area that FA personal computer use is most widespread.

The equipment and device level is constructed from a control station and facilities consisting of a microcomputer, dedicated controller, actuator, sensor, etc. The control station and facilities are responsible for the actual processing, assembly and inspection. Recent demands to upgrade station functions for network and MMI (man-machine interface) compatibility have led to the use of personal computers. Fuji Electric provides a mount-type FA personal computers to meet these needs.

The shop control level connects the factory management and cell control levels. Shop level systems are responsible for controlling the real-time flow of materials and information between cell groups on the shop floor. The ability to dispatch production instructions from the factory management level to the cell control level in real-time and to process, also in real-time, the various information collected in the cell control level is becoming increasingly important as CIM systems become more popular.

4.2 Distribution concepts

In a Mini-CIM system, as with large scale CIM systems, an ideal system cannot be constructed at once. It is important that the infrastructure is fully equipped and that improvements such as on site automation are made from the bottom up. Many users have their ideal CIM system in mind and want to be able to construct that system easily and quickly on site. For these cases, the system units and the location are very important. In a factory, production is done in cooperation with other sections including engineering works, production control, and design. For mini-CIM, each section's job content, function and control

units, as well as the relation between the job and the flow of information and data base are taken into consideration and the system units are arranged into six sections as shown in Fig. 4. Information from a data base common to all sections is shared through file server stations arranged on the network. The functions for each of the six sections are distributed over each section corresponding to the hierarchical level of the Mini-CIM. Only one FA personal computer or FA workstation is shown for each level in Fig. 4. However, in actuality, depending upon the job and function, several FA personal computers or FA workstations may be allotted for distributed processing.

An example of the order entry and shipment control section is shown in Fig. 5. Systems below the shop control level are constructed with the usual consideration of control and function risk dispersion.

The FA personal computers and FA workstations which are distributed on each level, are installed with software packages which are standardized according to functions. Necessary packages are selected to systematically construct the CIM system.

Fuji Electric, with its many years of experience, has developed these packages. VAR (value added reseller) companies are also developing packages in cooperation with Fuji Electric.

5. Afterword

The concept of Mini-CIM, one type of CIM, was presented above. Fuji Electric will continue to improve the functions and performance of FA personal computers and FA workstations, to enhance related hardware and software products, and to facilitate the construction of Mini-CIM based distributed processing systems.