CIM for Magnetic Switches

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1. Introduction

The electrical apparatus industry has moved from mass production of limited types of products to small amount production of various types of products. Based on demands for short delivery times and other diverse customer needs, a highly efficient, flexible Computer Integrated Manufacturing system (CIM) has been developed to increase current operation efficiency.

This article discusses the CIM process for magnetic switches (new SC series) currently being produced at Fuji Electric's Fukiage factory and the CIM system outline.

2. Fukiage CIM Magnetic Switch Factory

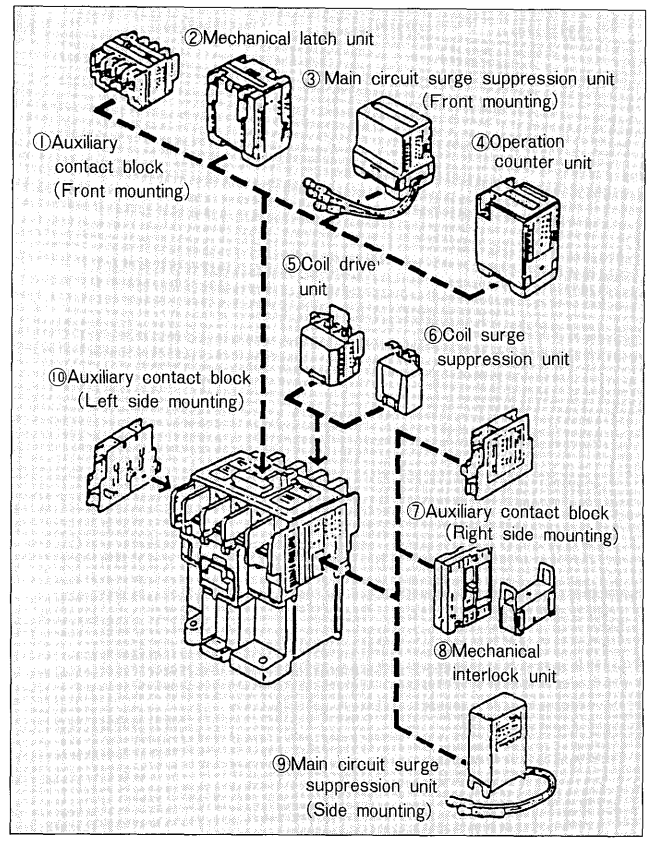
2.1 Development of CIM structure for magnetic switches

Since Fuji Electric began manufacturing magnetic switches in 1954, the product line has maintained top market share. Along with an entire mini-magnetic switch model change, the design/manufacturing technology and systems were completely renovated for the new SC series (orange line). Five billion yen have been invested and a new CIM factory completed. A CIM factory where the processes of order receipt, daily planning, production schedule dispatch, manufacturing, and shipping are integrated, makes it possible for a product to be shipped within 24 hours of receiving an order from any nationwide sales office or distributer terminal.

In constructing a CIM system the concepts of the three base technologies: product design technology, production technology and production management were clearly defined in order to clarify the targets to be aimed and the relationships among the base technologies. The status of operation with the conventional product was studied and analyzed in detail according to requirements of the CIM concept.

This study includes an examination of conventional manufacturing line problems and data of order-made products, cost analysis of 8,000 types and 20,000 parts and detailed analysis of lead times, status of works in progress and organization, skills and human factors of workers. The results of the study were classified and used in the development of this CIM system. Concurrent development of the products, manufacturing facilities, production systems and equipment neccessitated close cooperation of members in headquartes, sales offices and factories in each working group. The result is that with design modularization and options which are easily attached after assembling, the goal of design for manufacturability has been realized. (See **Fig. 1**) These modules form the core of the data base and are linked from production arrangement to part control and cost calculation.

Fig. 1 Newly developed magnetic switch series

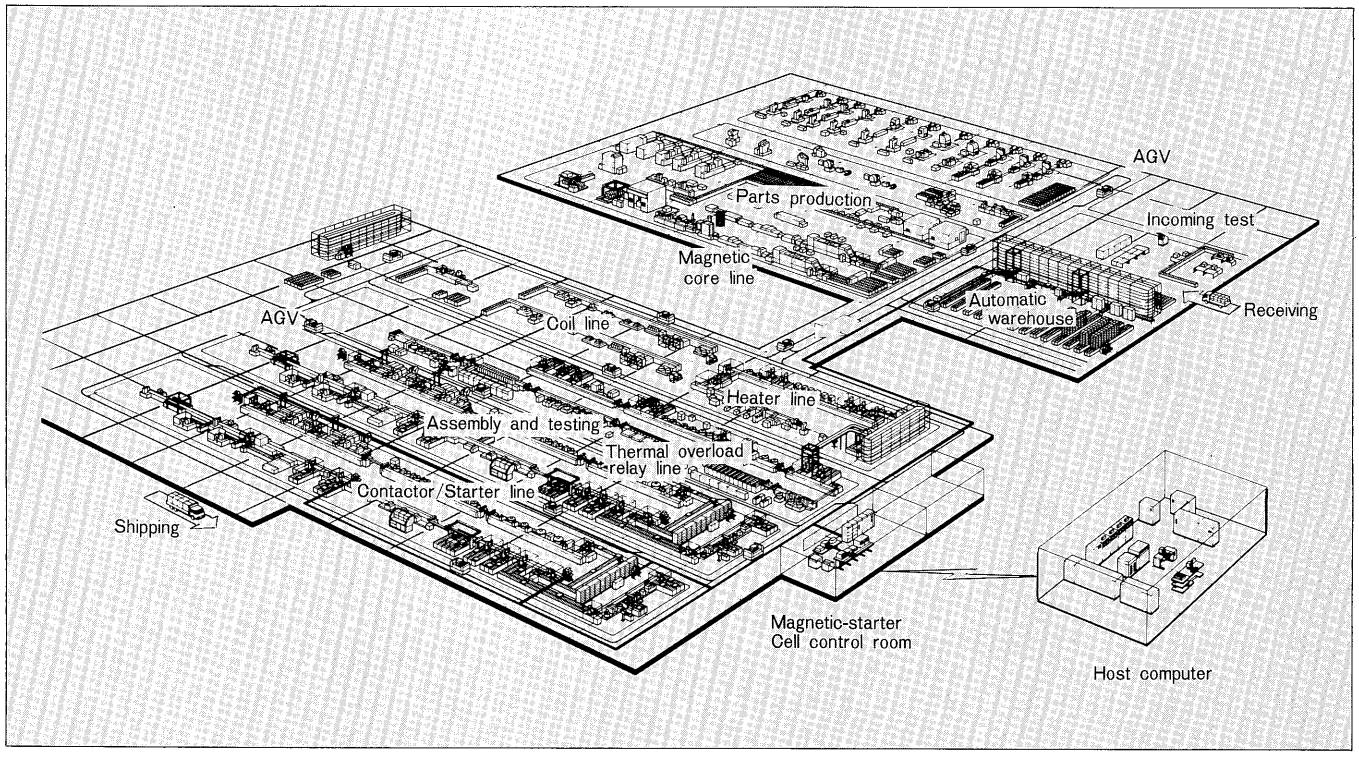


2.2 Outline of CIM magnetic switch facility

The goal of a CIM magnetic switch facility was to be able to manufacture and ship within 24 hours of order receipt. The CIM facility layout is shown in **Fig. 2**.

7,800 square meters of new space was added to an existing building to form a facility where parts processing

Fig. 2 Layout of CIM facility



through assembly is performed on one floor with a unified flow of information and materials. Information on orders received is input to the host computer at the Fukiage factory. The daily schedule is planned according to delivery date instruction. The daily assembly order is automatically scheduled from the cell control room and dispatched to the FA personal computer on each line. This dispatched information is copied onto each magnetic switch in the form of a barcode. By means of reading this information, magnetic switches with differing specifications can be assembled. Required parts are automatically supplied by a just-in-time process to each assembly line by 13 automatic guided vehicles from a nearby automated warehouse. At this facility approximately 8,000 varieties of magnetic switches are assembled. Production capacity is 2,000 units per hour.

Main features are listed below.

(1) parts processing and assembly on one floor, combination of an automated warehouse and automatic transport reduce lead time
(2) mixed production, automatized trimming adjustment, inline printing, elimination of setting time for multiple part assembly, uniform quality manufacturing
(3) automated scheduling dispatch and the related automatic setting in assembly line
(4) automated parts supply to assembly line with exclusive part carrying pallet, data transmission by means of data carrier (FAMDAS) and barcode
(5) an information network linked to outside suppliers which processes order receipt information in real time

2.3 Outline of production information system

Figure 3 is a block diagram of the total CIM system showing parts and information flow. The goal of this information system with integrated sales and manufacturing is for reduced information lead time, accurate information transmission, and keeping unified sales and manufacturing information.

2.3.1 Integrated products information system (ARISS: All Round Information System Standard product)

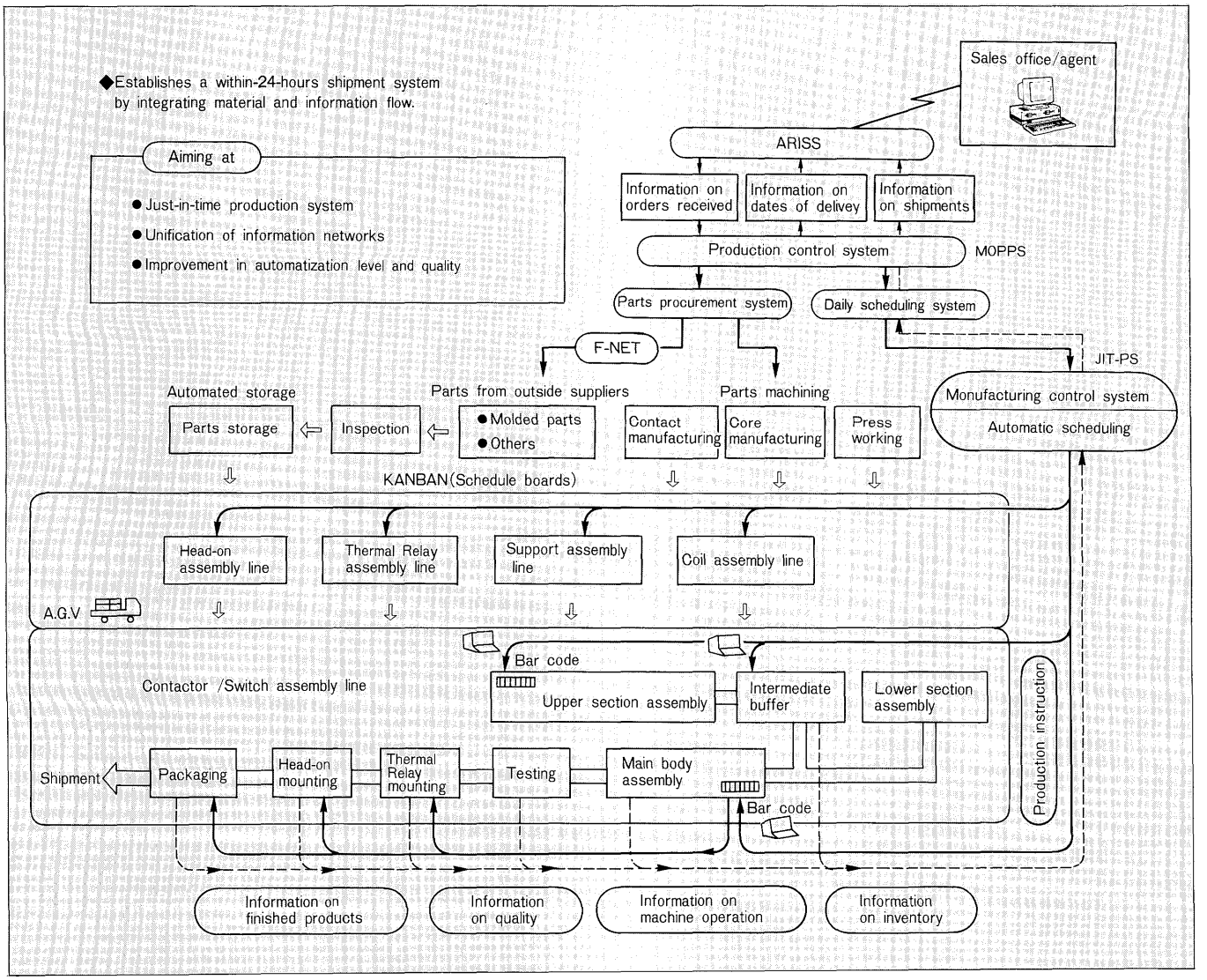
19 Fuji Electric sales office locations, 150 distributor locations, the main office, subsidiaries including the Fukiage factory, and 9 sales office warehouses are connected by a network over which order receipt information is transmitted. This network consists of an order receipt and production arrangement system, a warehouse inventory management system, and a delivery information system, etc.

2.3.2 Production management system (MOPPS: Market Oriented Products Production System)

Order receipt information is received from ARISS in real time and assembly plan for the next day is planned. After the final confirmation in the next morning, the data is immediately sent to the lower level manufacturing management system. After the order is received, assembly instructions are dispatched with the objective of meeting the delivery date and maintaining the smallest amount of inventory and goods in progress.

This system consists of a parts procurement system, and a daily scheduling system, etc.

Fig. 3 Structure of CIM system



2.3.3 Manufacturing management system (JIT-PS: Just In Time Production System)

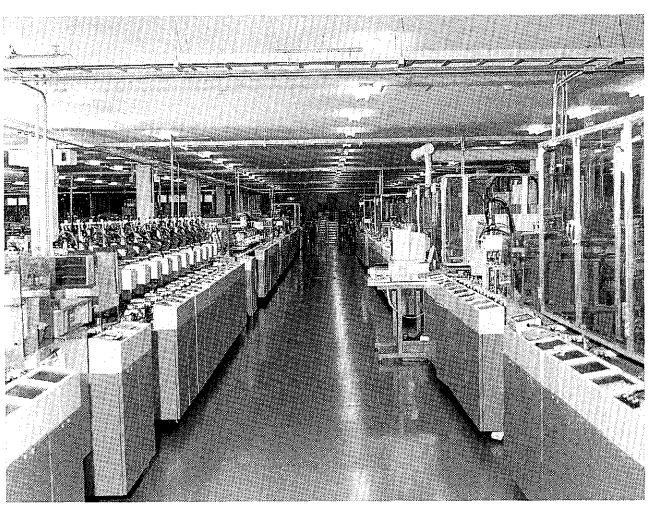
Using an UFAS 300 system (UFAS: Universal Factory Automation System) an assembly parts requisition instruction is received from the upper level production management system. Instructions are dispatched to the physical distribution system and to automatic assembly machines, etc. on the production line. This system consists of an automatic scheduling system, schedule dispatch system, and production result system, etc.

2.3.4 Line supervision, control system

Approximately 30 FA personal computers are used in parts processing, assembly, inspection, test systems, automated warehouse, transportation management and control. Processing and assembly instructions, result collecting, parts and products use status, and completion result are monitored and controlled on line for each automatic machine.

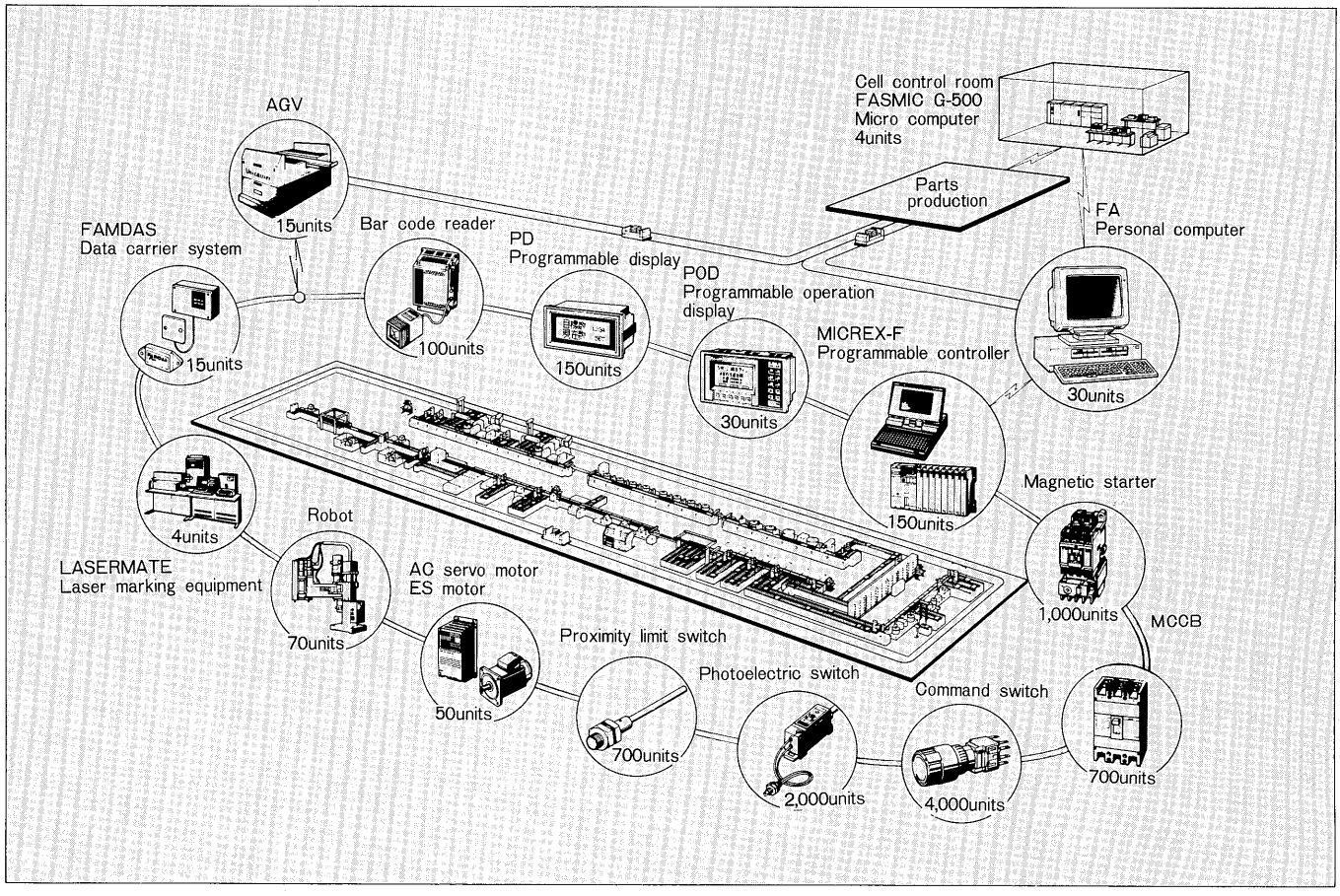
The system has a network between the ARISS system, MOPPS system, JIT-PS system, line supervision and control system and the outside supplier's online system.

Fig. 4 Standardized automated-assembly-line



Order receipt information is processed in real time. In this system, within 24 hours of receipt, an order can be produced and shipped.

Fig. 5 Automated assembly lines supported by Fuji's FA components



2.4 Outline of automatic assembly line

The magnetic switch automated assembly line is divided into the following sections: the upper section assembly line where electrical contact parts are assembled, the lower section assembly line where internal core and cushion system parts are assembled, and the main body assembly line (U-shaped line). The upper section has approximately 20 different types. The main assembly has a temporary stock of these 20 types so that assembly can begin as soon as the order is dispatched. The customer's order is placed at the front of the main assembly line as an automatically scheduled assembly order instruction. This information is copied in the form of the barcode which contains all the customer's product specifications. Parts selection and assembly for the upper and lower section sub assemblies and approximately 40 types of coils and springs is based on barcode information. The assembly lines are so-called automatic mix assembly systems. The lead time for assembly, testing and packaging is approximately 7 minutes after assembly instructions have been received at the main assembly line.

Approximately 90% of the 130 new machines (system equipment mainly consisting of parts processing and automated assembly machines) at this CIM facility were designed and manufactured in-house; resulting in a thoroughly standardized line. (See **Fig. 4.**) Automation equipments include Fuji Electric's assembly robots and a wide use of her controls and sensors. (See **Fig. 5.**)

The combination of past experience and know how with newly developed technology has achieved a high assembly rate of 3 seconds per unit.

2.5 CIM effectiveness

With the introduction of CIM, improved product organization accompanied by the development of new manufacturing technology has reduced the number of metal molds and manufacturing equipments resulting in a higher return on investment and automatization rate of 97%. Product modularization, integration and an information network allows a quick response to the customer and has reduced lead time and manpower by 2/3 and lowered inventory by 1/3.

3. Conclusion

A CIM facility for manufacturing electrical apparatus was introduced above. In the future, while adding improvements and making a general purpose system, we will promote the development of FA components, introduction of new technology, and increase of employee skill level which is crucial for the use and application of CIM. Applications of CIM to other products and factories and the next generation CIM foundation are to be considered.