

# The Trend of Instrumentation and Control Technology

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## 1. Introduction

From a marketing point of view, although the high exchange rate of the yen has been rectified and industrial output has recovered, equipment investment for the private sector demands includes few new constructions for expansion of production. It is mostly comprised of intensive equipment arrangements to develop competitive power in price as well as for the extension, conversion, and replacement of rationalization.

The price of industrial products greatly dropped between 1993 and 1995. Also, Japan's output of industrial instruments fell from 1991, as shown in Fig. 1, and bottomed out during these two years. Annual growth of about 3% is expected in the future.

The world's process automation systems (PAS)

centering around distributed control systems (DCS), with an output of about 800 billion yen in 1996.

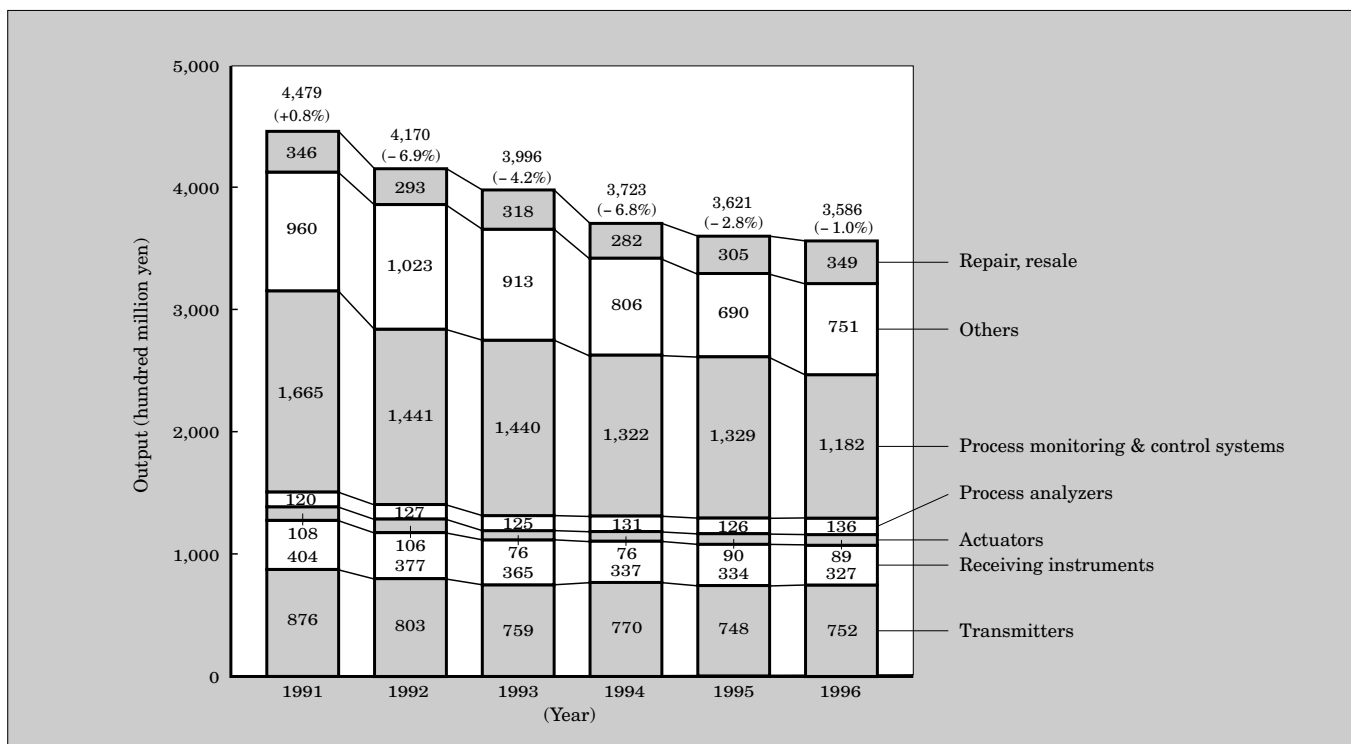
On the other hand, the world's major industrial instrument manufacturers are promoting innovative technical development and developing strategies to integrate enterprises by mergers and acquisitions (M&A).

This paper reviews the current trends in the world and Japan and describes Fuji Electric's plan for developing information and control systems and measuring instruments.

## 2. Trends of Information and Control Technology and the Market

Recently, the integration of control and information has been regarded with more importance and it is

Fig.1 Change of output of industrial instruments  
(Source: Japan Electric Instrument Industries Association, Annual Report 1997-7)



necessary to consider for information and control systems.

## 2.1 Key elements in technical innovation and system configuration

The key elements in technical innovation are open networks, open databases, and multimedia having personal computers (PC) as the core. A conceptual diagram of the trends in technology and the market is shown in Fig. 2.

### 2.1.1 Wide use of PCs and Windows NT<sup>\*1</sup>

The technical innovation of PCs has accelerated and new products improving cost performance are announced every several months. Moreover, due to the abundance of package software with advanced functions produced from the open development environment, the use of PCs has rapidly increased not only for information processing in office automation (OA) but also on a personal level.

Due to the improvements in PC hardware efficiency and reliability and in Windows NT real-time operation and reliability, PCs have been applied in process automation (PA) and factory automation (FA) as well as in OA.

Windows NT has been replacing many companies' own operating systems (OS) and UNIX<sup>\*2</sup> as the OS for human communication interfaces (HCI) in the world of information and control systems. In the future, when compatibility with system scales and performance requirements is verified, the system domain for Windows NT will spread widely.

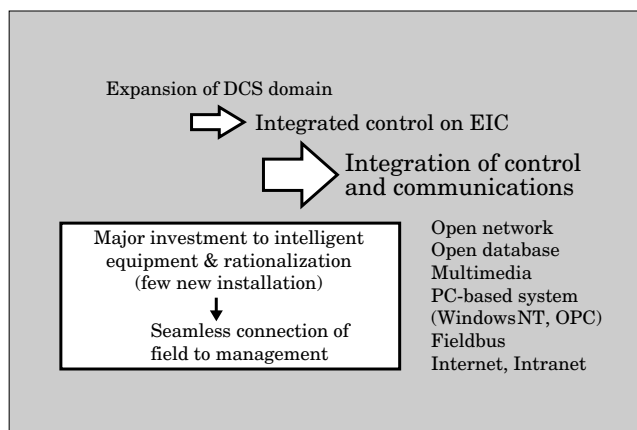
### 2.1.2 Promotion of open networks

Network for information and control systems are classified into three stages: information, control and

\*1 Windows NT: A registered trademark of Microsoft Corp., USA

\*2 UNIX: A registered trademark in the USA and other countries and is licensed by X/Open Company Ltd.

Fig.2 Conceptual diagram of trends in technology and the market



field networks. An open information network has already been achieved. Worldwide standardization and business partnerships are being strategically promoted to attain open networks for the other two stages.

### (1) Application of the intranet to information networks

In order to connect plant information to the management system or carry out management not under the control of regional restrictions, the intranet is now able to allow easy access to information on business management, maintenance, and data analysis. This will have a positive affect on data acquisition by the management and engineering support for operators.

### (2) Open field networks

The Fieldbus Foundation has two kinds of fieldbuses; the low-speed fieldbus for PA instrumentation signals (H1) and the high-speed fieldbus for connecting controllers or remote PIO to controller (H2). With regard to the H1, several companies' products based on the final specifications were extensively displayed and mutually connected at INTERMAC '97. In 1998, several manufacturers scheduled to market their products.

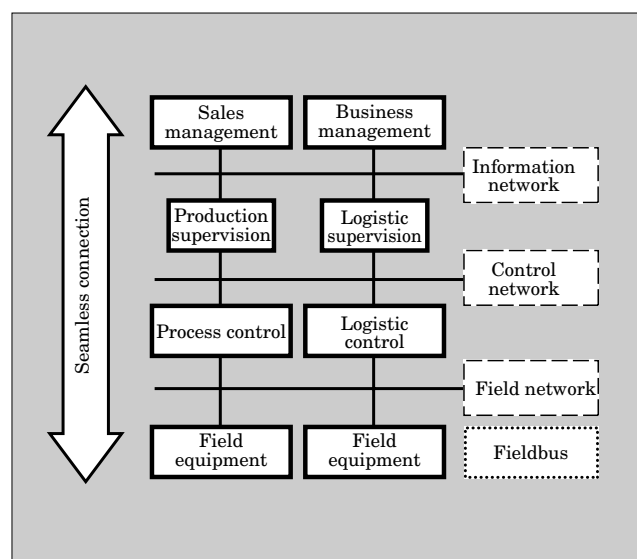
Open fieldbuses will give users the advantages of (1) open multi-vendor systems, (2) remote calibration and changing of the setting constant, (3) high accuracy measurement, and (4) transmission of status signals.

### 2.1.3 Seamless connection of the field to management

Sales, production, and distribution are closely connected in the manufacturing industry, and timely data transmission from each division is required by the other divisions. Formerly, each division worked out its own systems and many efforts were made to connect information between the divisions.

In contrast, information between divisions will be

Fig.3 Conceptual diagram of seamless connection of field to management



directly connected in the future by an open network, just as if they were structured as system. This will result in a system in which the direct connection of sales, production, and distribution allows exact judgment and prompt policy determination.

A conceptual diagrams for the seamless connection of the field to management is shown in Fig. 3.

## 2.2 Technical domain of the next generation system

Fuji Electric's next generation system aims at seamless connection of the field to management by expanding the range of information communication

Fig.4 Technical domain of the next-generation system

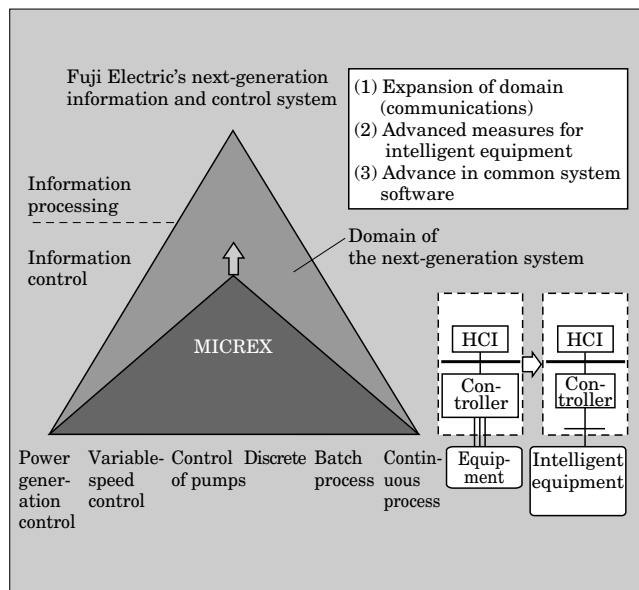
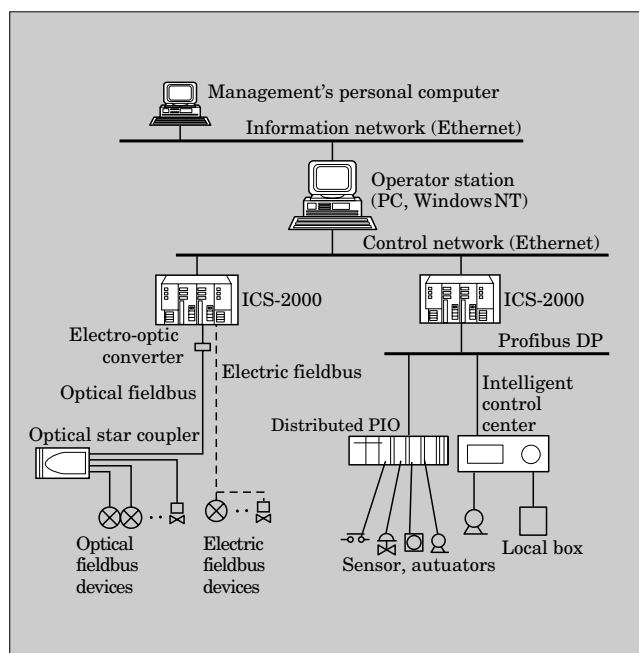


Fig.5 FOCUS open EIC-integrated system



functions.

On the other hand, by developing the fieldbus, Fuji Electric promotes open interfacing systems with intelligent sensors and drivers. As a result, part of the controller functions will be included in the sender and driver. In the control systems, the weight of the sensors and drivers will be increased, and the function and position of the controllers will be greatly changed.

By developing open system software, Fuji Electric can quickly take measures to meet any situation. A conceptual illustration is shown in Fig. 4.

## 2.3 Fuji Electric's information and control systems

Fuji Electric has supplied many systems with the electric, instrumentation, and computer control (EIC) integrated system MICREX-IX. Furthermore, we have developed the advanced information and control system MICREX-AX as an upper level type of the MICREX-IX that uses an open local area network (LAN) (TCP/IP, conforming to FDDI) and multimedia, enhancing the information processing function.

In October 1996, Fuji Electric marketed the PC-based open integrated control system FOCUS for medium and small systems. This system is based on Windows NT and uses Ethernet<sup>\*3</sup> for the information and control networks. Recently, the system has been developed to meet the fieldbus as a field network, further contributing to an open network. In addition, the system can be connected to an intelligent control center through the Profibus. These features combined with an ICS-2000 advanced EI-integrated controller, compose an open EIC-integrated system that incorporates the specifications of the next-generation system. This system is shown in Fig. 5.

## 3. Trends of Measuring Instruments

From the viewpoint of instrument manufacturers' output, the long stagnation of private demands and the problem of exchange rates forced many enterprises into restructuring, and the instrumentation industry has finally attained a stable period with a hopeful future.

In the instrumentation industry during this period, the prices of process instruments dropped by 20 to 30%. This resulted in pressure on the management of instrumentation suppliers and a wave of inevitable worldwide reorganizations through M&A. Under these circumstances, a reduced products cost was not enough. Seeking further improvement in efficiency, Fuji Electric established the specialty instrumentation supplier/Fuji Electric Instruments Co., Ltd., an enterprise which will quickly adapt to market changes and respond to customer requirements.

\*3 Ethernet : A registered trademark of Xerox Corp., USA

### 3.1 Field instruments

Fuji Electric's production and sales of instruments have gone worldwide. After having launched a manufacturing and sales company in China, Fuji Electric established Fuji Electric France S.A. in 1995 and Thermax-Fuji Electric Ltd. in India in 1996.

Differential pressure transmitters are internationally produced and are supplied only by a limited number of manufacturers. Therefore, Fuji Electric intends to promote development not only for regular components but also for needs that include peripheral components. In the meantime, Fuji Electric's products are ranked at the top level in the world in every respect regarding function, performance, and price. They are highly rated by many users.

Recently, level meters were added to comply with the sanitary specifications for the pharmaceutical and food industries and the small diameter flange specification for differential pressure flow meters for the oil and petrochemical industries and for general-purpose use. This completed the product line meeting customer needs.

Fuji Electric considers ultrasonic flow meters to be important basic measuring components in the future in addition to pressure or differential pressure transmitters. Demand is expected to greatly increase. Following the sale of portable ultrasonic flow meters in 1995, we carried out overall improvement of the fixed installation ultrasonic flow meters and improved measuring accuracy and response characteristics as well as greatly reduced the effect of bubbles in the fluid. In addition, they were reduced in size and weight and supplemented with the functions of multi-path measurement and multi-pipe application, which resulted in advanced functions and performance.

Sanitary specifications, underwater types, and explosion-proof types have been added to complete the line of electromagnetic flow meters.

Fuji Electric has recently developed commercial fiber-optic fieldbus instruments.

A topic of the technology is that Fuji Electric has newly developed an optical star coupler, the key component, and applied it to the H1 level fiber-optic fieldbus system. With the cooperation of Chiyoda Corporation, it is currently under field trial in the Shell pilot plant in the Netherlands. It is expected to greatly contribute to safe operation in hazardous areas and regions that suffer heavily from lightning.

### 3.2 Panel instruments

In the field of panel instruments (controllers, indicators, and recorders), Fuji Electric has marketed new temperature controllers and recorders. The high, middle, and economy-class temperature controller series were completed earlier, but ten years have passed since the economy class was marketed, so an overall model change has been undertaken to reduce costs and

improve the functions.

The new series has the following advantages for easy and useful application:

- (1) Addition of a small front size of  $48 \times 24$ mm (a first in Japan) that improves compatibility with small machines
- (2) Addition of a waterproof front face increases environmental endurance
- (3) Specification of 24V AC and 24V DC
- (4) The fuzzy control function as standard for the whole series reduces overshoot and improves disturbance immunity

Other temperature controllers have been marketed. These have the same construction as the existing function models for position control and communication for the PLC.

These temperature controllers are suitable for medium and small machines that are mainly controlled sequentially and also require temperature control at several points. The advantage is that two independent loops can be controlled with one module and a fuzzy control function is also installed.

With regard to recorders, a new type has been added to the ink jet recorder series that Fuji Electric has consistently developed.

Chart recorders are rapidly becoming daily necessities. Someday, high-class types will replace the simple types, and hybrid recorders will occupy the market.

The new type based on the concept of economical, analog-like hybrid recorders is characterized by simple recording and digital printing and meets the current requirements.

### 3.3 Analyzers

Fuji Electric's analyzers are mainly used for processes and the environment. The major types are infrared and oxygen analyzers.

Japanese market for process analyzers has remained the same these past several years, but the environmental analyzers changed the downward trend beginning in 1993 to an upward one in 1996.

Recently, the market is growing for analyzers used in the reduction of dioxin generated by incineration plants. The Western nations promote the tightening of control over exhaust gas from stationary sources and automobiles. Pacific Rim countries have begun to as well, and an increase in demand should follow.

Under these circumstances, Fuji Electric has improved analyzers for environmental measurement and has supplied a number of CO/O<sub>2</sub> analyzers to measure dioxin in incineration plants as well as flue gas analyzers for boilers.

As for water quality analyzers, to meet requirements for safe and good tasting water, Fuji Electric has developed new products in anticipation of the future. Acute toxicant monitors utilizing biotechnology, optics-applied floc sensors, chemistry-applied triha-

lomethane analyzers, optics and chemistry-applied supply water quality monitors (color and turbidity analyzers) are characteristic products developed by combining biotechnology, chemistry, and optics to our own sensor technology. Also, a highly sensitive turbidimeter was developed based on measuring technology using scattered laser to count particles in ultrapure water for semiconductor processing. This turbidimeter can measure low turbidity of 0.001mg/L and count particles of 0.5 $\mu$ m or more and can precisely perform turbidity control of outlet water from the filter basin of a water purification plant in accordance with the tentative guidelines issued by the Ministry of Health and Welfare as countermeasures against

cryptosporidium in the water supply.

#### **4. Conclusion**

Recent information and control systems and measuring instruments have been reviewed. Global industries will overcome the borderless price competition by rationalizing technology, production, and control as well as by speedy management. Utilization of superior information and control systems is indispensable in reinforcing competitive power. With our advanced technology, Fuji Electric will make efforts to offer instruments and information and control systems meeting customer needs.





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