

# Present Status and Prospects for Instrumentation and Control Technology

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## 1. Introduction

The recent world recession has exerted tremendous influence on domestic production of industrial instruments (Fig. 1). Industry is not aiming at equipment investment based on expansion but instead at reorganization towards modernization and rationalization of the 21st century.

In the trend of information and control systems, there is a major wave of "downsizing and open systems" in the computer and information processing fields, which greatly impacts control systems. Sensors and field instrumentation devices are progressing in intelligent system and network applications, thus diversifying application ranges.

Since the third-generation, Distributed Control System (DCS) MICREX was put on the market in 1987, bearing the slogan "PA, FA, and Total Automation", Fuji Electric has continued the technical development of not only measuring and control instruments that render services in and out of the country but also system integration (SI) of overall information and control systems. The company began selling the fourth-generation MICREX-IX\*1 in October 1992, continuing technical development to match the trend and needs of the times, including the preparation of a wide variety of measuring instruments.

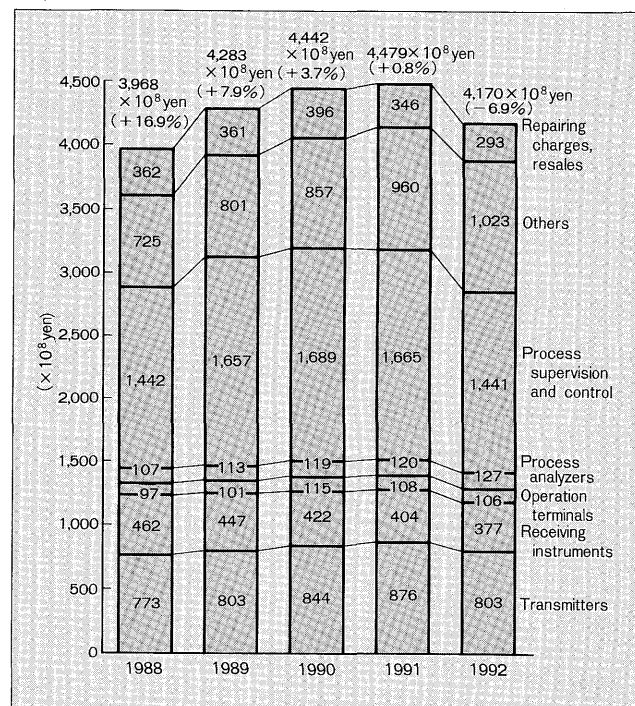
While this special edition introduces the results of recent developments, this paper will review the technical trend of information and control systems, and measuring devices which back these developments.

## 2. Trend of Information and Control Systems

As for "downsizing and open systems" in the field of computers and information processing, functions shared between large main frames and distributed processing at workstations has posed problems for opened networks as well as UNIX\*2, which has an open operating system.

From the user's standpoint, "modernization of operation" is a problem as we approach the 21st century. This modernization aims at measures to combat the 3 D's

Fig. 1 Production trend of industrial instruments



(Dirty, Difficult and Dangerous), reduce working hours and field patrols, promote unattended and automated night operation, and extend repair intervals. In order to achieve this, abnormality diagnosis, maintenance support systems, operation training with the use of a simulator, and integration of the control room, to create a production center are planned (Fig. 2).

With these trends as a background, future targets of information and control systems are as follows:

### (1) Integrated and open DCS

This will expand and develop a DCS aiming for "EIC integration." Its aim is almost identical to what is called "Process CIM." The network LAN is important for such a system.

### (2) Field distributed systems

Sensors and actuators, which support information and control systems, enhance the systematization of field devices. As a field network (bus connection), the standardi-

\*1: The IX of MICREX-IX stands for integrated and extended control systems for the next generation.

\*2: UNIX operating system is developed and licensed by UNIX System Laboratories Inc.

zation and practical use of the "fieldbus" is expected. Among these, an optical bus is distinguished, and Fuji Electric has supplied the "Fiber-Optic Field Instrumentation systems FFI" as the only fieldbus currently used in petroleum, petrochemical, and many other plants, all showing satisfactory results.

### (3) Expansion and development of AI

It is necessary to promote AI from the practicality development phase through the expansion phase in order for it to contribute to the true automation of operation, including on-site fine tuning by the operator.

## 2.1 Integrated control system MICREX-IX

The fourth-generation DCS "Integrated control system MICREX-IX", which began selling in 1992, was developed utilizing the latest technology to match the trend of information and control systems described above. It has superseded MICREX and promises open systems and further development in the future.

The expanded and reinforced main functions of

MICREX-IX are as follows:

- (1) The Man-Machine Interface (MMI) has high resolution, so operation is facilitated (Integrated Operator Station IOS-2500).
- (2) The system has an integrated DCS and a Programmable Controller (PLC), which increase flexibility of control functions. It can be directly coupled with an FFI optical fieldbus, aiming also at a future fieldbus (Integrated Control Station ICS-2500).
- (3) The installation of an instrumentation and electrical control function and an MMI can be done on a general-purpose personal computer using a window system (Integrated Engineering Workstation IES-2500).
- (4) TCP/IP (Ethernet\*<sup>3</sup>) as a general-purpose LAN has been standardized in MICREX systems to achieve open system.
- (5) The system and an open UNIX computer DS/90, put on the market in January 1993, can be directly connected using the dataway DPCS-F or a general-purpose LAN, which reinforces the computer linkage function.

The DS/90 is able to utilize many of the "ISV (Independent Software Vender) software", a merit of the open UNIX workstation. This linkage can combine the merits of the UNIX computer DS/90 and the DCS MICREX-IX.

## 2.2 Development of information and control systems centered around MICREX

Figure 3 shows key words for past developments (marked with a ●) and expected future developments (marked with a ○) of information and control systems with MICREX at the core. Important points for future development are as follows:

- (1) Inclusion of computer functions

\*3: Ethernet is a registered trademark of Xerox Corp.

Fig. 2 Trends of information and control systems

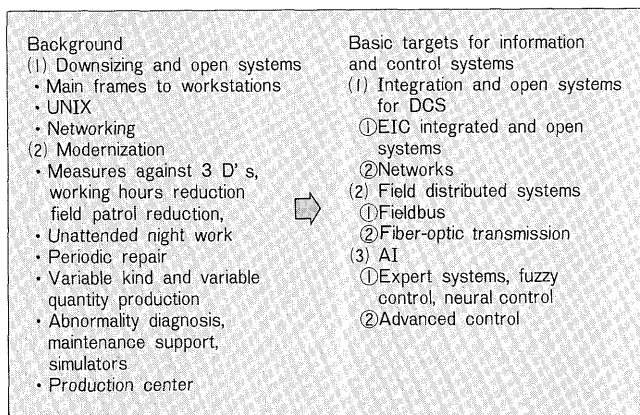
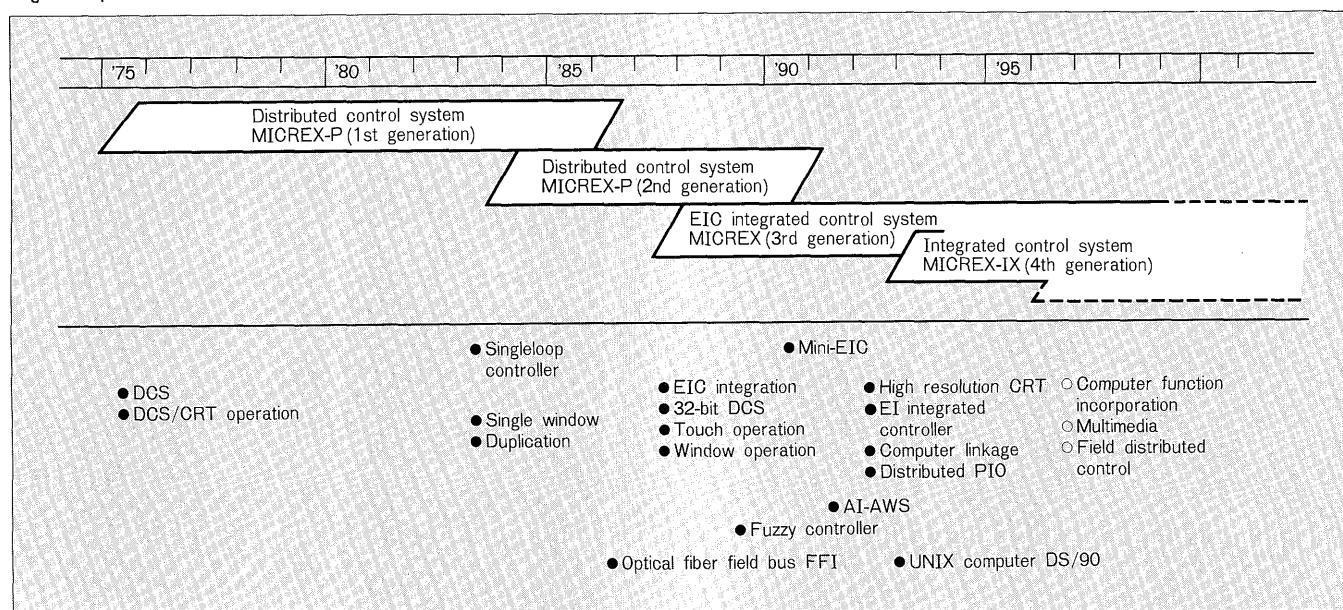


Fig. 3 Expansion of distributed control system MICREX



- (2) Use of multimedia for communication and HCI (Human Computer/Communication Interaction/Interface)
- (3) Field distributed control with fieldbuses

Fuji Electric plans to achieve these developments as well as to improve upon the MICREX system by adopting advanced technologies and expanding systems to accomplish the following:

- (1) MULTIBUS II\*<sup>4</sup> as the core of the hardware
- (2) FCL (Functional Control Language) as the core of the software
- (3) Integrated control LAN DPCS-F as the core of the system

### 3. Trends of Measuring Instruments

#### 3.1 Field instrumentation devices

Field instrumentation devices, such as transmitters and operation terminals, have been digitized and made intelligent. Signal transmission systems have been developed from pneumatic systems and electronic systems of DC 4 to 20 mA (analog systems) as well as smart systems (a hybrid of analog and digital systems) and optical fiber type FFI (digital systems). With regard to digital transmission, fieldbuses fall under the international standard. A number of companies are planning a joint field test.

The "electronic transmitter FCX series", utilizing Fuji Electric's characteristic micro-machining technology and having a unique analog-smart convertible, is highly rated by users worldwide. Fuji Electric has developed a double-coating FCX capable of preventing the permeation of injurious hydrogen, a problem of transmitters in petroleum and chemical plants. Field results have been satisfactory.

FFI systems have amassed a long list of customers, including off-site facilities for petroleum plants by adopting an optical fieldbus owing to the advantages of fiber-optic transmission and easy systematization with a DCS. A proposal concerning this fiber-optic fieldbus was submitted to the IEA/ISA Fieldbus Technical Committee and a draft was developed. An international standard is being developed for both the fieldbus and the electronic fieldbus.

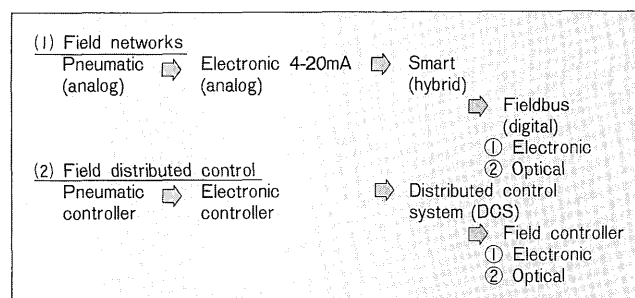
Fuji Electric put on an informative exhibition of fieldbus compatible FCX series transmitters and DCS MICREX-IX in conjunction with other companies at the International Electric Measuring Instrument Industry show (JEMIMA) in October 1993.

Figure 4 shows "trends of field instrumentation systems" in the future development of the field bus market. Fieldbus application for field networking, a basis for field distributed systems with field controllers, will be a major wave of the future.

#### 3.2 Receiving instruments

Receiving instruments (panel instruments), such as indicating and recording meters and controllers, are employed because of their ability to coexist with and com-

Fig. 4 Trends of field instrumentation systems



pensate for DCS development; accordingly, they are highly developed from a technical standpoint.

"Hybrid recorders", using Fuji Electric's special ink-jet recording heads, have a series width of 180 mm and 100 mm. They are provided with a T-link transmitting function, which facilitates systematization with MICREX or an FA personal computer.

"Compact controllers" are also provided with a T-link transmitting function.

In conjunction with the "Z series" temperature controllers utilized in the machine industry and for simple instrumentation, the "Fuzzy controller X" using a fuzzy control function has been developed. In addition, a new type of "program controller" with a liquid crystal display has been put on the market.

### 4. Conclusion

The main achievements of Fuji Electric's instrumentation and control technology outlined above have been presented at the "JEMIMA show" in Tokyo in October 1993. This show included a symposium of the Society of Instrument & Control Engineer as well as an exhibition of fieldbus devices currently under international standardization.

As the manufacturing industry progresses into the modernization and internationalization of the 21st century, a fundamental review of such DCS concepts as distributed field systems and open systems is taking place. We believe that the integrated control system MICREX-IX will play an important role in modernizing the future of the manufacturing industry.

We believe "integrated and open systems" which the integrated control system MICREX-IX aims at will continue to be a basic concept of information and control systems from now on.

We are striving to develop new technology and supply products that will satisfy users in the measuring instrument field.

Guidance and cooperation of users and manufacturers of our products will be greatly appreciated.

\*4: MULTIBUS II is a registered trademark of Intel Corp.