

***Control
panels
2030***

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Control panels 2030

1	Issues and background in control panel industry
1.1	Changes of the environment for control panel
Recently, in production site of each domestic manufacturing company, high functionality of production equipment is required according to the environment changes which are such as market globalization and product diversification. In response to them, FA devices mounted on control panel are increasing and the works are getting more complicated by enormous wiring. Moreover, viewing the domestic labor force, labor shortage continues by reason of lack of technical experts and specialists.	
1.2	Changes of control panel technology and user needs
Looking at technical aspects, control devices have become increasingly multifunctional, high-performance and compact. With these advances, it is considered that some are leading to space-saving of	

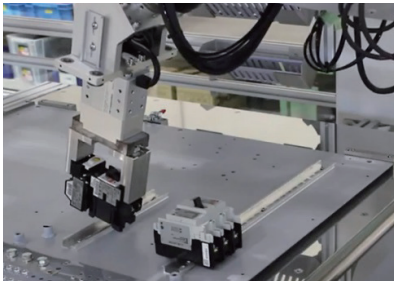
panel, or no enclosure as possibility. In addition, there are emerging tools that can be used as countermeasures for the labor shortage, such as streamlining of board-design, collaborative robots, IoT and AI. Under these circumstances, the control panel industry is at the turning point of previous manufacturing, and there is an urgent need to secure human resources and improve the environment.

On the other hand, in terms of user needs, the trend of openness of industrial equipment is unavoidable, and it is certain that it will be necessary to adopt a common language and to carry out the implementation of cyber security measures. With regard to future control panels, not only the optimization of individual products but also the optimization of the entire system and the overall optimization of the product life cycle are required, as product cost.

1.3 Issues of the control panel industry for the future

In response to the labor shortage, the digital age, and the changing needs of users, there is an issue that the innovation must be realized while envisioning the future of the control panel. To address this issue, it is important to explore the gaps, assuming the current situation and the future, and to consider what is needed to solve them. In addition, as one of the solutions to future issues, the role of the coordinator company is important, such as optimizing manufacturing production and coordinating companies utilizing the strengths of individual companies. In future, the control panel industry is expected to utilize a coordinator company, and is expected to make a significant contribution to increasing the added value of the control panel industry.

Based on the above, the proposals for solving issues in the control panel industry for the future are described on the following clauses.



Installation of devices by robot



Utilization of design data

Source: i-DEN CO.,LTD

2 Vision of control panel for 2030

2.1 Labor saving in assembly work

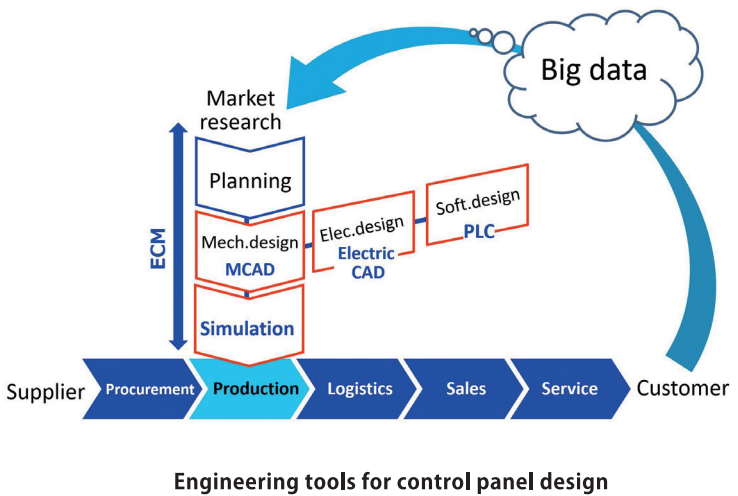
As data standardization progresses, it becomes easier to utilize design data at manufacturing sites. It is possible to automatically generate a wiring instruction from an electric circuit diagram, and a program for an assembling robot from a device layout diagram.

2.2 Efficiency in electric design

Today's control panel designs can be broadly divided into "electric circuit diagrams", "device arrangement diagrams", "harness diagrams", and "sheet

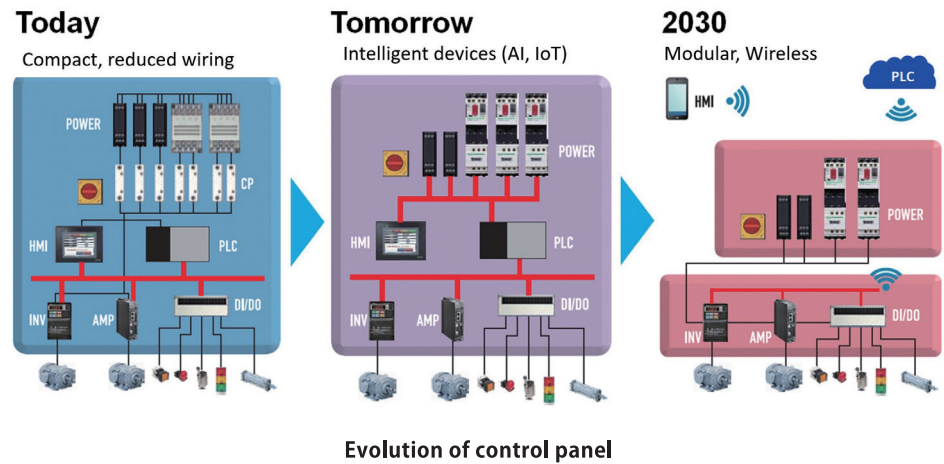
metal diagrams". Taking the control panel of an industrial machine as an example, the electrical circuit diagram and the equipment layout are generally created by an electric (control) engineer, and the sheet metal diagram is generally created by a machine designer. In addition, control engineers use PLC.

Thus, designing a single control panel requires several types of engineering tools. In addition, because the format for saving differs for each tool, mutual cooperation of design data has not been achieved. Standardization of the data format of various tools and improvement of design data portability will improve design efficiency.



2.3 Added value to control panels

As design data is digitized and standardized, and reuse and deal are performed, the quality of control panels will be leveled to some extent regardless of where they are manufactured anywhere in the world. Control panel manufacturers have own limitations, such as "predictive maintenance" using AI and "visualization" from remote , so open innovation (co-creation) with equipment vendors is required. In 2030, 5G (fifth-generation mobile communication) will be widespread in factories, and industrial networks will have been wireless.



3 Evolution in the control panel industry

3.1 Modularization

Generally, "interchangeable components" are called modules. It is modularization that is to introduce an appropriate standardized model for







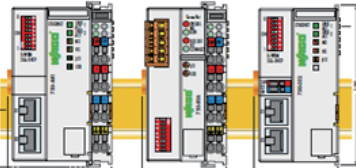



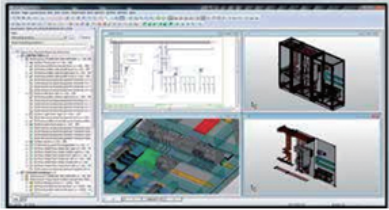




components, based upon the evolutionary process for cost and manufacturing. Modularization requires standardization of functional blocks and interfaces, but once this is realized, the value chain, from development, procurement, production, sales and after-sales service, are possible to be made more efficient by standardizing on a module basis.

Modularization of the control panel is roughly classified into the following two types.


(1) Modularization of hardware as functional blocks such as enclosures, control devices including PLCs and terminal blocks, cables, power supplies, motors and inverters.


(2) Modularization of software such as control programs executed by PLCs, which are functional blocks, CAD data and order / procurement data.


Specific examples of the two types of modularization are in the following.


Type	Typical example	Outline	Objectives
Hardware	 Modularized control panel equipment	<ul style="list-style-type: none">30% reduction in assembly time and manufacturing costVarious hardware modules linked to CAD dataPanel divided into Hot Zone and Cool Zone to optimize energy consumptionExemption of some IEC standard conformity certification tests	    
	 I/O-SYSTEM	<ul style="list-style-type: none">The number of nodes can be reduced by combining each function moduleApplicable to various open networks (PROFI-NET, MODBUS / TCP, EtherNet / IP, CC-Link IE)	  
Software	 Electrical CAD software	<ul style="list-style-type: none">Reusable and modifiable module data structuresVarious chart data linked in real time by drag & drop operationIntegrated management of input / output terminals / pins, relay contact usage, etc. using the database navigator	   


(Legend)


 Space saving


 Man-hours reduction

 Cost reduction

 Optimizing standard certification

 Energy saving

 Efficient maintenance

 Shorter Delivery time

Source : Product catalog of specific companies

Example of modularized equipment and tool for the control panel

3.2 Evolution of connection between modularized products

3.2.1 Rationalization of wire connections

Technique and experience are required for wiring electrical equipments especially for screw tightening and torque management. But, since labor

shortages have occurred, it's difficult to secure skilled workers. And it's expected that a more serious situation will be faced in the future.

In such situation, the adoption of the screwless terminal block without screw tightening and torque management is increasing even in Japan. And not only control line but also high current over 100A have been adapted. By using it, the following can be realized.1) Shortening of wiring work time, 2)Stability of connection quality, 3)Improvement of safety. Many screwless terminal blocks directly connect wires or use pin terminals. But for high current, a ring terminal is selected from the viewpoint of reliability based on usecase. Therefore screw less terminal block was not widely used. But, screwless terminal block has begun to be used even at high current connections, such as the launch of Hirose Electric's screwless terminal block (Zero Screw) that can connect to ring terminals.

By the screwless connection will be popular for the panel, wiring work by the robot instead of the worker will be realized in the future, and further labor saving is expected.

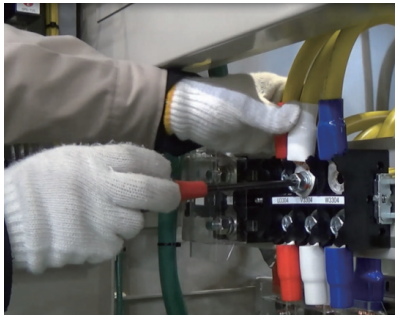
3.2.2 Generalization of wireless communication in field net works

Various approaches to wireless communication have been promoted at manufacturing sites, but the control by wireless networks has not yet been popular. Towards 2030, 5G is expected to have a significant impact on Automation's business.

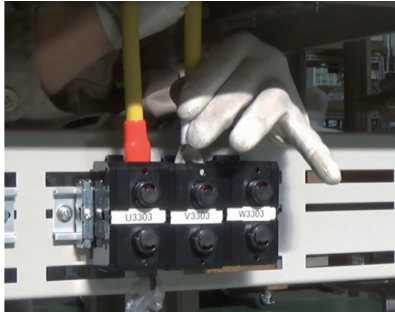
In factories, the need for wireless communication is increasing due to the cost reduction of wiring work and the complexity of networks. Wireless communication is an effective solution for communication between buildings and for monitoring equipment and utilities at the edge of a factory site. Wireless communication has been used in the field of equipment monitoring. The majority of factory managers have agreed to use wireless communications for monitoring, but are cautious about wireless control.

400MHz and 900MHz radios have been considered suitable for automation in Japanese factories, but are not widely used, contrary to expectations. Because the design and maintenance of wireless networks is not familiar to factory managers. And The facts that there is no wireless communication killer application makes difficult the expansion of wireless networks in factories. Wi-Fi and Bluetooth are used as OA networks, not control networks. The introduction of mobile phone IoT is rapidly progressing because of its reduced communication charges and high security. In the field of process automation, the promotion of WirelessHART and ISA100 has prospered, but it seems that it will take some time to spread it.

5G is expected to be the leading role of next generation as control wireless communication. In 2022, a low-latency 5G radio was developed and provided to the market, and will make a great leap forward as a radio communication



Screw terminal block



Screwless terminal block:ZERO SCREW

Wiring of screw-type terminal block and screwless terminal block

Source: HIROSE ELECTRIC CO., LTD

for control. As the number of wireless applications in the control field increases, the control functions of PLCs shift to the cloud. 5G has a significant impact on the architecture of the control cabinet. 5G, a potentially disruptive innovation, will bring significant changes to the business of automation.

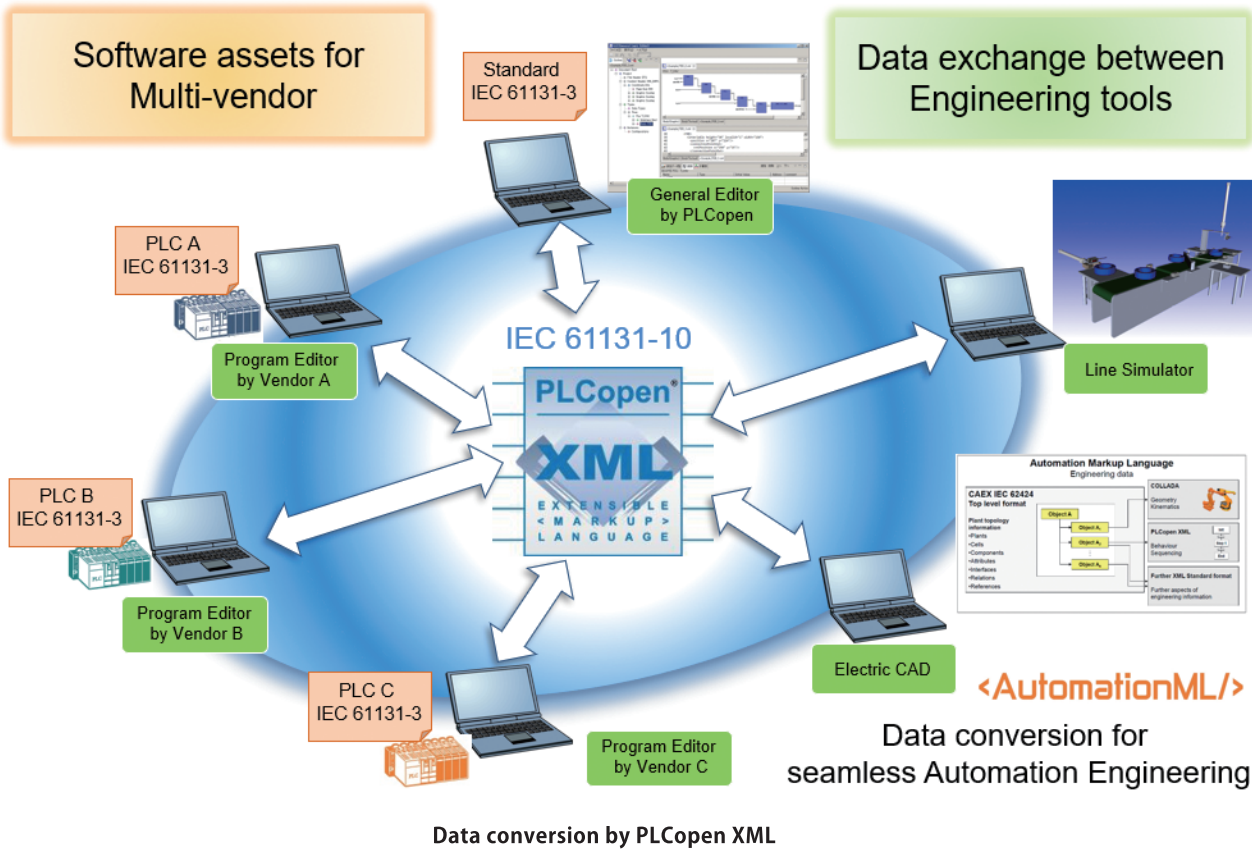
3.3 International standardization of design data format

International standardization activities for data storage format are in progress. PLCopen®, an organization that promotes to disseminate international standards for PLC programs, proposed a manufacturer-independent program standard format (PLCopen XML) to the IEC, and was issued as an international standard in April 2019.

In addition, AutomationML can express necessary design data (position, operation, etc.) using XML in an integrated manner for factories and plants, and enables data exchange standard between various discipline industrial tool, it is spreading mainly in Europe.

AML adopts PLCopen XML as a data format for sequential control and operation descriptions.

As design data is standardized, samples are provided from other makers/manufacturers, and new businesses such as “design data transactions” are created.

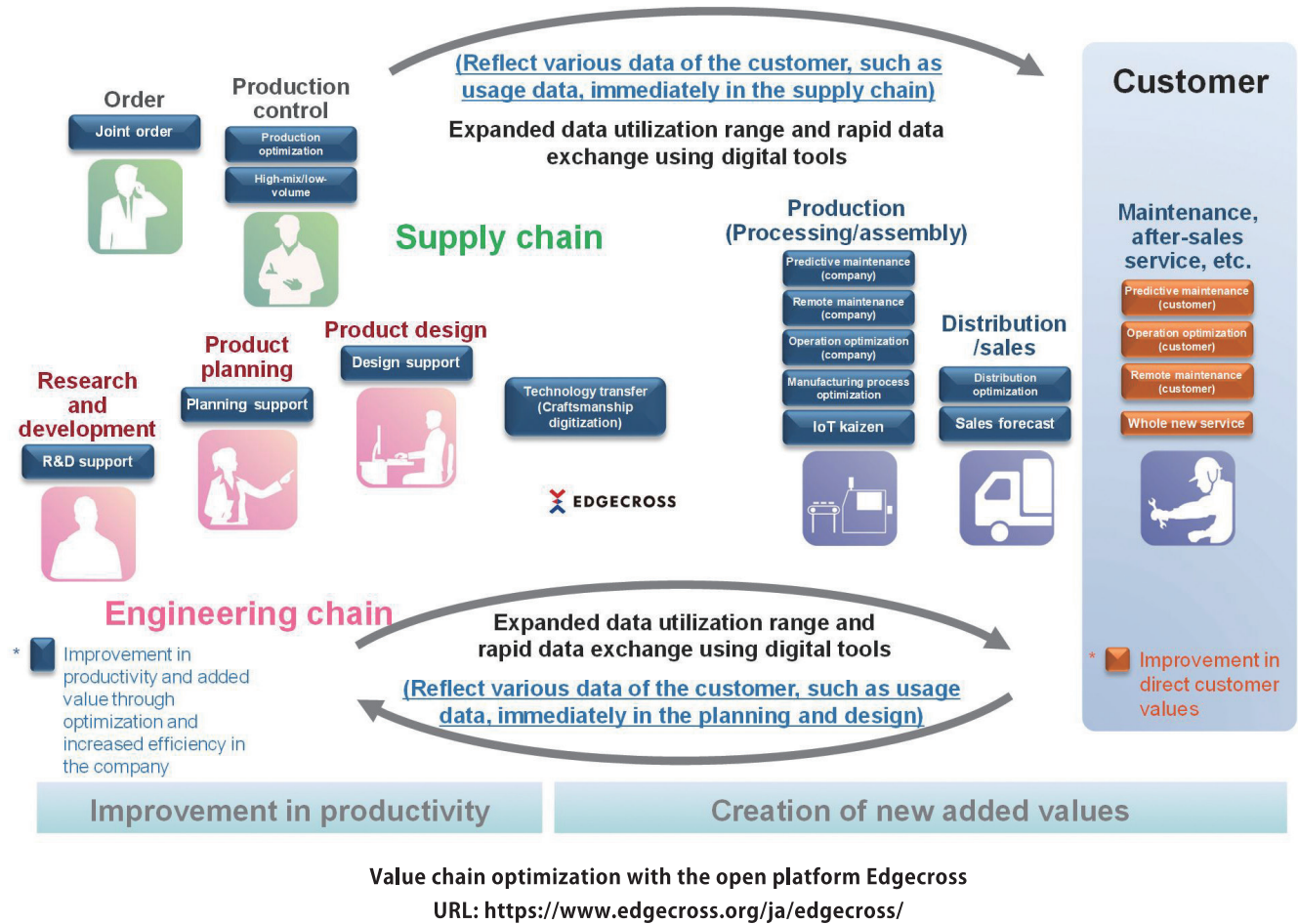


3.4 Value chain optimization of control panels

In the control panel production, manufacturers in charge of each manufacturing process, such as sheet metal, painting, and assembly, shares

the production information connected to the network on the integrated platform, and the coordinator companies which integrate production systems will be able to optimize the entire production system across the engineering chains and supply chains.

As an example related to the integrated platform, Edgexross Consortium is offering the open platform "Edgexross", on which companies are able to connect with each other. This platform is an open software platform in the edge computing area which realizes cooperation between FA and IT beyond the boundaries of companies.



3.4.1 Evolution of supply chain

Optimization of supply chain enables sales and procurement on Web. For example, "NITTO KOGYO" in Japan enables the design, drawing, and estimation for enclosures with processing required for the manufacture and installation of control panels. And they achieve a short delivery time by ordering on Web.

Overseas, customers can use their web systems, such as "EPLAN" to use the parts data for planning and design and order it themselves.

In addition, a system that can easily place orders for special products without the need for human will be developed, creating an environment that supports the custom needs of various small lots in transactions.



Inside control panel temperature monitoring device (OMRON)



Device-Panel design information application by code (EPLAN)

3.4.2 Adding high value to maintenance by IoT in control panel device

By linking devices which compose a control panel to other devices, even and operators or maintenance persons, the monitoring of equipment conditions and predictively detecting of the equipment failure are enabled so that continue the optimal production. Furthermore, if more devices are connected to the network, the aging deterioration and the operating condition of equipment can remotely be monitored that the maintenance can be effectively performed according to the equipment condition.

Now that IoT has already been deployed to some devices, failure detection. In addition, the predictive maintenance can be remotely performed by mounting a device in the control panel which to monitor the temperature inside panel, detect abnormal heat generation on the control panel, and transfer the data.

Meanwhile, we are presently working on some frameworks as IoT deployment. One is that to attach QR code® and read it with a mobile device etc. so that quickly acquire the design information from product information and utilize it on-site. Another is that to improve maintenance efficiency by utilizing AR technology. In the future, standardized format of data across different manufactures, and common of application software will be essential for realizing of significant reduction in maintenance work.

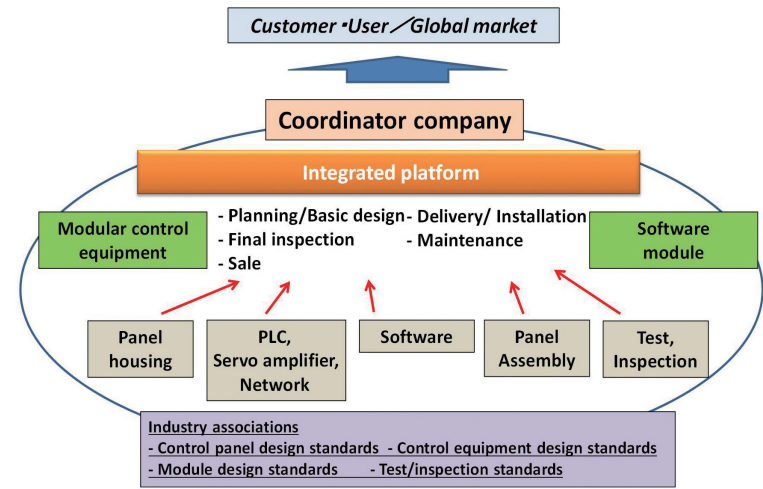
4 New business for control panels

With the globalization of the industrial machinery market and the rise of emerging countries, diversification and short life of manufactured products are progressing, and modularization and flexibility of machinery and equipment are required. In order to diversify products, machine remodeling

and rearrangement of production line are needed to add functions to products. Also, due to the shortened life of products, the lead time from ordering to delivery is shorter than before.

Due to these changes in the environment, control panels have been required to evolve, such as miniaturization, reduced wiring, follow to international standards, and more efficient ECM and SCM.

Under these circumstances, a "coordinator company" will be born which will select the most appropriate module, coordinate between manufacturers, and optimize ECM and SCM through digitalization. The coordinator company operates an integrated



Position of coordinator company and industry associations

platform and provides the added value of optimizing the entire control panel system.

In the field of modularization, future activities will include modularization of products and engineering chains, standardization of interfaces between modules, and development of related standards. In addition, it is necessary to evaluate the responsibilities in the supply chain, especially the management risk of the coordinator company when a complaint occurs.

In order for coordinator companies to optimize ECM and SCM, it is desirable to establish a platform which connects a coordinator company and application provider companies, to manage purchases and designs by platform users. And to foster a business environment which can shift from vertical integration to a horizontal division of labor production environment is also desired. Optimization of control panels and business advancement by modularization are necessary to respond to changes in the environment.

In order to solve the above-mentioned problems, the industry association must work together to promote cooperation in the industry and find the optimal coordinator company and composition of the integrated platform from a global perspective.

5 Members of contol panels 2030 WG

Contol panels 2030 working group

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(Chairperson)	Takashi Matsukuma	OMRON Corporation
(Member)	Daisuke Sawai	OMRON Corporation
	Hiroya Kurihara	Hirose Electric Co.,Ltd
	Katsuhiko Yamaguchi	nVent Japan
	Kenji Kokubo	Nitto Kogyo Corporation
	Koichi Furusawa	Mitsubishi Electric Corporation
	Koichi Katayama	Mitsubishi Electric Corporation
	Makiko Naemura	Hitachi Industrial Equipment Systems Co., Ltd.
	Nobuhiro Kojima	Fuji Electric Co., Ltd.
	Syuichi Kakumura	Hirose Electric Co.,Ltd
	Takashi Hisazumi	Toshiba Mitsubishi-Electric Industrial Systems Corporation
	Tetsuzo Igata	EPLAN Software & Services.K.K.
	Yoichi Hayama	Fuji Electric FA Components & Systems Co.,Ltd/
		Nippon Electric Control Equipment Industries Association
	Yutaka Kawaragi	Japan Switchboard & control system Industries Association
(Secretary)	Goro Owaku	Japan Electrical Manufacturers'Association
	Kazuhiko Tanaka	Japan Electrical Manufacturers'Association
	Tomoya Abe	Japan Electrical Manufacturers'Association