FACTORY AUTOMATION

FA-IT Integrated Solution
e-F@ctory

Connect everything
GLOBAL IMPACT OF MITSUBISHI ELECTRIC

Through Mitsubishi Electric’s vision, “Changes for the Better” are possible for a brighter future.

Changes for the Better

“Changes for the Better” represents the Mitsubishi Electric Group’s attitude to “always strive to achieve something better”, as we continue to change and grow. Each one of us shares a strong will and passion to continuously aim for change, reinforcing our commitment to creating “an even better tomorrow”.

Mitsubishi Electric is involved in many areas including the following:

Energy and Electric Systems
A wide range of power and electrical products from generators to large-scale displays.

Electronic Devices
A wide portfolio of cutting-edge semiconductor devices for systems and products.

Home Appliance
Dependable consumer products like air conditioners and home entertainment systems.

Information and Communication Systems
Commercial and consumer-centric equipment, products and systems.

Industrial Automation Systems
Maximizing productivity and efficiency with cutting-edge automation technology.
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| e-F@ctory Alliance                                                      | 33 |
The industrial world has come to a major turning point with the introduction of the Internet of Things (IoT). The key to surviving today’s severe market competition is the prompt and timely implementation of IoT/optimization; not only on the production shop floor, but also throughout the monozukuri field.

In response to this need, we developed the “e-F@ctory” FA-IT integration solution. At its core is “edge computing,” advanced technologies that utilize AI to collect data from the production shop floor and analyze it in real-time, thereby improving monozukuri. Utilizing wide-ranging knowledge and technologies, as a comprehensive FA manufacturer cooperating with more than 1,000 partner companies,* we are disseminating e-F@ctory around the world. With us, you can implement “one-stop” operations using optimum IoT proposals for the shop floor, and realize the digital shift throughout monozukuri.

In Japan, and around the world, e-F@ctory innovation connecting all things and optimizing all areas of monozukuri has already started.

*as of September 2021
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*as of September 2021
This solution solves customers' issues and concerns by enabling visualization and analysis that lead to improvements and increase availability at production sites.

By utilizing FA and IT technologies, we will reduce the total cost of development, production, and maintenance, continue to support customer improvement activities, and propose solutions that aim for monozukuri that is one step ahead.

FA-IT integrated solutions

**Evaluation index for IoT to promote e-F@ctory SMKL (Smart Manufacturing Kaizen Level)**

We will contribute to the realization of smart factories by providing a "simple, easy-to-understand indicator" to show "to which target" and "to what extent" IoT has been implemented for factories where IoT (data visualization, AI-based improvements, etc.) is promoted. It will become possible to separate visualization and management targets, grasp the current position to evolve manufacturing step by step, evaluate the direction of IoT promotion, and make systematic investment decisions.
To realize **e-F@ctory**

### iQ Edgecross

For improving the entire shop floor, it is essential to gather data from all kinds of equipment, but this requires a complicated system structure because an actual shop floor always consists of equipment and facilities made by various manufacturers where different connection methods and protocols are involved. Mitsubishi Electric contributes to improvement of our clients’ production floors by facilitating use of “Edgecross”*1 that is an open software platform in the edge computing area and by supplying applications that are suitable for various needs of clients.

1. Software platform in the edge-computing area that synchronizes FA and IT The Edgecross Consortium, of which our company is one of the organizers, is developing and promoting the specifications. The number of members is approximately 373 companies (as of August, 2021).
2. Software to perform various processes for utilizing data at the production floor
3. Software that enables seamless data integration with systems in the cloud and on-premise servers
4. Software component to collect data at the production floor via various networks

### CC-LinkIE TSN

**“Integrating FA and IT” and “High speed and accurate control”**

- By adopting TSN (Time Sensitive Networking) which achieves real-time communication with a time sharing method, different networks can coexist on a single cable
- Also this efficient protocol will achieve high speed & accurate control

Due to these technologies, CC-Link IE TSN enables seamless cooperation between FA and IT systems, making it possible to utilize various applications in manufacturing industries.

* Ethernet is a trademark of Xerox Corporation.

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**e-F@ctory Alliance** is an FA partner program which aims to offer our customers the optimal solution across the entire supply and engineering chains through strong alliances with partners who provide software and devices highly compatible with Mitsubishi FA products and system integration partners who build systems using such products.
The key to creating a smart factory is edge computing.

For a smart factory to be achievable, the real-time utilization of production shop floor data and efficient connectivity with IT systems are essential. With e-F@ctory, by utilizing “edge computing,” a technological concept for information processing between the shop floor and IT systems, it is possible to achieve data connectivity with optimal efficiency.
An Environment
Where Manufacturers Participate Freely

Edgecross is an open software platform operating in edge computing environments built in collaboration with members of the Edgecross Consortium* to enable FA and IT collaboration. It is possible to build a free and flexible edge computing environment independent of application vendors and device manufacturers.

Edge applications
- Executes various processes such as monitoring, analyzing and diagnosing data from shop floors
- Possible to choose appropriate applications from an abundant lineup

Edgecross
- Controls the collection, processing, diagnosis and feedback of data utilized in edge computing
- Abstract hierarchical management of production floor lines, equipment and devices

Data collector
- Regardless of device manufacturer or network, collect various shop floor data
- Collect data from existing facilities

Edge computing Products

*Edgecross Consortium is an organization for formulating Edgecross specifications and promoting dissemination. https://www.edgecross.org/en/
e-F@ctory IoT Solutions Cover Everything from the Production Shop Floor to IT Systems.

Linking the Production Shop Floor and IT Data

**GENESIS64™**
Offering solutions for various needs relating to supervisory control.

**MES Interface Product Lineup**
Link databases without using computers or programs.

**C Language Controller (with applications pre-installed)**
Supports abundant connections, such as MQTT, REST, and SECS.

Data Analysis/Diagnosis Utilizing Edge-Computing

**MELIPC Industrial Computer**
Achieve edge-computing utilizing various data from the production shop floor.

**Real-time Data Analyzer**
Data analysis/diagnosis software equipped with abundant statistical methods and AI.

**GT SoftGOT2000**
HMI software capable of abundant GOT functions using a computer or panel control.

IoT Shift and Data Collection on the Production Shop Floor

**Simple CPU Communication Function**
CPU has built-in Ethernet function that enables device data to be transmitted easily between controllers using only parameter settings.

**GOT Device Transfer Function**
Transfer data between various PLCs using only parameter settings. Capable of connecting Mitsubishi Electric PLCs and those of over 20 other companies.
Mitsubishi Electric is strengthening not only production shop floors and IT systems, but the entire edge-computing field in order to achieve further optimization and higher efficiency. We propose IoT solutions that suit our customers’ goals, covering everything from collecting shop floor data to analysis and diagnosis, even including connectivity to IT systems and clouds.
Introduction of Solutions

e-F@ctory leverages knowledge accumulated to date to find the optimal solution for each industry type and process.

e-F@ctory was launched in 2003 and has helped many companies solve various issues. From the knowledge accumulated down through the years, e-F@ctory proposes optimal solutions for each industry type and process to achieve productivity and quality improvements, cycle-time reductions, preventive maintenance, "visualization" of energy, energy savings and so on.

Solutions Introduced

- Lead-time is long!!
- Shorter lead-time!!
- Improved productivity with efficient operation!!
- Thorough protection of information!!
- Poor equipment operability!!
- Don't understand security measures!!
- Achieving energy-savings!!
- High energy costs!!
- Fewer quality issues!!
- Can't reduce the number of reject parts!!
- Prevent shop floor accidents!!
- Concerned about equipment safety!!

Issues faced by the manufacturing industry

- Quality
- Sustainability
- Productivity
- Security
Solutions Introduced

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- Shorer lead-time!!
- Poor equipment operability!!
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- Thorough protection of information!!
- High energy costs!!
- Achieving energy-savings!!
- Concerned about equipment safety!!
- Prevent shop floor accidents!!
- Can’t reduce the number of reject parts!!
- Fewer quality issues!!

Streamlining all business tasks
Electricity and electronic fields require elaborate and complex work, yet a high percentage of tasks are still performed manually. A major issue faced is how to automate the processes of part loading, surface implementation, PCB assembly, unit assembly and shipment in order to reduce human error. e-F@ctory helps provide a solution to this issue by providing robots equipped with force sensors and work support systems.
Automotive/Automotive Parts Fields

In vehicle manufacturing plants that handle a vast number of parts and wide variety of processes, there is a need to solve various issues such as responding to mixed production of many different car models, improving production speed and quality, considering worker safety and engaging in environment-oriented initiatives.

e-F@ctory helps provide solutions to the issues customers face by offering optimal solutions through forming common platforms and alliances with many different partners.
In the food and beverage fields, where stringent quality control is essential, there is a demand to both maintain quality and achieve greater efficiency in areas such as high-accuracy process control to maintain temperatures, humidity and pressure, reduce equipment set-up changeover time, improve contamination measures and food traceability (product tracking, raw material retroactivity), and perform multifaceted inspections.

e-F@ctory contributes to the safe and secure production of food and beverages through versatile visualization and inspection systems using cameras and sensors.
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**Logistics Field**

The importance of “logistics reforms” as supply chain management is attracting attention. Mitsubishi Electric is building smart, efficient and safe logistics systems to meet issues such as reducing inbound and outbound times, improving cargo handling efficiency, and reducing overall equipment costs. We contribute to the optimization of supply chain management.

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**Distribution Warehouse**
- **Issues**
  - Improvement of operating rate
  - Elimination wasted energy
- **Solutions**
  - Predictive and preventive maintenance at the warehouse/machine/equipment level
  - Demand management for the entire warehouse

**Stacker crane**
- **Issues**
  - Crane stability and high-speed operation
  - Crane fault avoidance
- **Solutions**
  - By vibration control, and position calibration functions faster and more stable load/unload
  - Use of safety functions for cranes

**Conveyor**
- **Issues**
  - Easy start-up and variable speed operation
  - Ensuring safety
- **Solutions**
  - Simultaneous speed change through FR-E800 and the CC-Link IE TSN
  - Use of FR-E800 safety functions

**Sorter**
- **Issues**
  - Acceleration of cargo identification and sorting
  - Scanning cargo ID correctly even in bad conditions
- **Solutions**
  - Real-Time processing of cargo sorting data by CC-Link IE TSN communication
  - Stable scanning of Cargo ID during high-speed transport

**RGV/AGV**
- **Issues**
  - Avoidance of slip effect during high-speed operation and stop
  - Miniaturization of RGV/AGV
- **Solutions**
  - High response and high-precision positioning by combining multiple encoders
  - Space saving utilizing multi-axis amplifier

**Robot**
- **Issues**
  - Prediction of robot failure timing
  - Collaboration between humans and robots
- **Solutions**
  - Preventive and predictive maintenance function
  - Optimum layout utilizing cooperative robot
Lithium-ion battery field

Lithium-ion battery lines are large production lines consisting of electrode forming, lamination, inspection, packaging and shipping processes. By utilizing various technologies such as tension control, drive control, synchronous control, robots, and IT cooperation of Mitsubishi Electric FA equipment for the equipment of each process, lithium-ion batteries can be produced efficiently and with high quality.
Packaging Machinery Field

Due to the diversification and complexity of needs, the packaging form of food and beverage products is constantly changing. In addition, machinery that performs packaging and packaging itself requires greater reliability and functionality than ever before. Mitsubishi Electric’s packaging equipment system facilitates the construction of systems according to each customer’s purpose and scale.

### Horizontal pillow device
The film roll for packaging is sent out horizontally, and both ends are sealed and cut while wrapping food sent from the conveyor in pillow shape.

### Vertical pillow device
The film roll for packaging is sent out vertically and molded into a bag. After putting food in the bag, the top of the bag is sealed and cut.

### Filling equipment
Fill solids and liquids to the optimum amount.

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**Building systems tailored to purpose and scale**

#### BASIC
For low-mix, high-volume production

- **Issues**
  - I want to keep the initial cost down
  - I want to build a system with minimal equipment

- **Solutions**
  - Control using mechanical cams
  - Simple configuration

#### MIDDLE
For high-mix, low-volume production

- **Issues**
  - I want to stabilize the quality of packaging
  - I want to respond flexibly to specification changes and setup changes
  - I want to reduce takt time

- **Solutions**
  - Control using electronic cams
  - Easy launch with iQ Monozukuri PACKAGING

#### HIGH
For high-mix, low-volume production

- **Issues**
  - I want to easily build a high-quality, flexible system
  - I want to perform predictive maintenance of equipment and reduce downtime

- **Solutions**
  - Control using electronic cams
  - Easy launch with iQ Monozukuri PACKAGING
  - Predictive maintenance and traceability are also supported.
Mitsubishi Electric's Nagoya Works introduced e-F@ctory and, as a result, has benefited from significant improvements in areas such as productivity, quality, energy-savings and safety, as well as establishment of security.

### 01 Improving Productivity with Operations Management/ Energy-savings/Work Support Systems

<table>
<thead>
<tr>
<th>Issues</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilization of operating rate by reducing incorrect part implementation</td>
<td>Introduction of a system using a C controller for managing surface implementation</td>
</tr>
<tr>
<td>Shorten time required to analyze failure causes</td>
<td>Introduction of a screw-fastening support system using a display screen</td>
</tr>
<tr>
<td>Alleviate burden on experienced operators who give instructions</td>
<td>Introduction of a system for managing energy savings of air-conditioning and lighting using GENESIS64™ and a PLC</td>
</tr>
<tr>
<td>Safety measures for operators who perform loading/unloading work</td>
<td>Introduction of a vertical conveyance system using a safety PLC</td>
</tr>
</tbody>
</table>

#### Benefits

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Energy cost</th>
<th>Poor quality</th>
<th>Productivity</th>
<th>Man-hours required to train new employees</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Approx. 30% reduction</td>
<td>Approx. 50% reduction</td>
<td>Approx. 30% improvement</td>
<td>Approx. 65% reduction</td>
</tr>
</tbody>
</table>

### 02 Improving Quality on the Assembly Line

<table>
<thead>
<tr>
<th>Issues</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support fluctuating demand and high-mix, varying volume production</td>
<td>Directly collect various information from equipment with a Manufacturing Execution System (MES) interface (PLC)</td>
</tr>
<tr>
<td>Improve equipment operating rate and quality</td>
<td>Directly connect equipment and a MES to strengthen information management and carry out various improvement activities</td>
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</table>

#### Benefits

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Lead-time</th>
<th>Machining time</th>
<th>Poor quality</th>
<th>System build time</th>
<th>Manufacturing timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Approx. 50% reduction</td>
<td>Approx. 40% reduction</td>
<td>Approx. 50% reduction</td>
<td>Approx. 65% reduction</td>
<td>Approx. 50% reduction</td>
</tr>
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*Figures assume calculations without computer and program.
Mitsubishi Electric’s Nagoya Works introduced e-F@ctory and, as a result, has benefited from significant improvements in areas such as productivity, quality, energy-savings and safety, as well as establishment of security.

### Case of e-F@ctory by Mitsubishi Electric (Nagoya Works)

#### Improving Productivity with Operations Management/ Energy-savings/Work Support Systems
- Stabilization of operating rate by reducing incorrect part implementation
- Shorten time required to analyze failure causes
- Alleviate burden on experienced operators who give instructions
- Safety measures for operators who perform loading/unloading work
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- Introduction of a screw-fastening support system using a display screen
- Introduction of a system for managing energy savings of air-conditioning and lighting using GENESIS64TM and a PLC
- Introduction of a vertical conveyance system using a safety PLC

#### Improving Quality on the Assembly Line
- Support fluctuating demand and high-mix, varying volume production
- Improve equipment operating rate and quality
- Directly collect various information from equipment with a Manufacturing Execution System (MES) interface (PLC)
- Directly connect equipment and a MES to strengthen information management and carry out various improvement activities

#### Improving Productivity with AI Robots
- Improve operating rate of lines with long man-hours
- Support production that is high-mix, small volume, high cycle
- Reduce equipment footprint
- Introduction of a robot production system that combines humans and machines
- Centralized management of quality/equipment information utilizing e-F@ctory
- Collection and management (traceability) of product data (barcodes) and quality (test) data for each piece of equipment
- Utilization of robot intelligent technology (assembly/inspection using force sensors)

#### Improving Productivity of the Camshaft Machining Line
- Improve line balance by shortening grinding time on bottleneck processes
- Management of production information by introducing e-F@ctory
  - Automatic work instructions to the machining line based on information from the host production management server
  - Expansion of unmanned operation with systematic set-up changeover and improvement of productivity
- Grinder-free system utilizing a C controller
  - Automatic calculation of lathe correction value from automatically measured outer diameter to achieve stable lathe finishing
  - Significant reduction in cycle time thanks to eliminating grinding of the motor-shaft portion

### Benefits

- **Productivity**: Approx. 30% improvement
- **Man-hours**: Approx. 55% reduction
- **Equipment footprint**: Approx. 85% reduction
- **Operating rate**: Approx. 60% improvement

### Issues

- Improve operating rate of lines with long man-hours
- Support production that is high-mix, small volume, high cycle
- Reduce equipment footprint

### Solutions

- Introduction of a robot production system that combines humans and machines
- Centralized management of quality/equipment information utilizing e-F@ctory
- Collection and management (traceability) of product data (barcodes) and quality (test) data for each piece of equipment
- Utilization of robot intelligent technology (assembly/inspection using force sensors)

### Benefits

- **Machining time**: Approx. 15% reduction
- **Productivity**: Approx. 30% improvement

### Nagoya Works
Mitsubishi Electric’s Fukuyama Works introduced e-F@ctory and, as a result, has benefited from productivity improvements and innovative energy-savings thanks to management of short stoppages.

01 Improving Productivity with a Short Stoppage Management System

Cases

GOT EcoServer III
Fukuyama Works

In the case of circuit breaker manufacturing lines, conventionally, people were in charge of status management and solving issues for each individual line, therefore there were delays in responding to short stoppages and improvements were only temporary.

- Management of operating status for all production processes at an equipment level
- Collection and analysis of management data online and in real-time
- Identification of cause behind problems and swift improvement

<table>
<thead>
<tr>
<th>Benefits</th>
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</thead>
<tbody>
<tr>
<td>Short stoppage occurrence: Approx. 75% reduction</td>
</tr>
<tr>
<td>Operating rate: Approx. 50% reduction</td>
</tr>
<tr>
<td>Improvement</td>
</tr>
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</table>

02 Energy-savings with Demand Management

Issues

Management and control of General Administration Building power demand

- Real-time measurement, collection and visualization of power consumption
- Automatic online adjustment of air-conditioning

<table>
<thead>
<tr>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Administration Building: 24% less energy consumption</td>
</tr>
<tr>
<td>Fukuyama Works overall: Approx. 100 million yen annual reduction in costs (base year: 1996, FY2010 results)</td>
</tr>
</tbody>
</table>
High-Efficiency Energy-savings Based on Production Status and Power Demand Forecasts

**Issues**

- Ongoing energy savings in smart meter production buildings overall

**Solutions**

- Effective demand peak shift with power demand, weather information, etc. managed online
- Measure load current for each piece of production equipment and control air-conditioning and lighting while detecting the presence/absence of operators

**Benefits**

<table>
<thead>
<tr>
<th>Air-conditioning/lighting</th>
<th>Annual power consumption reduction</th>
<th>In monetary value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approx. 20%</td>
<td></td>
<td>Achieve/maintain a reduction of approx. 500,000 yen</td>
</tr>
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**Iida Factory of Mitsubishi Electric’s Nakatsugawa Works introduced e-F@ctory and, as a result, reduced equipment downtime at low cost.**

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Reducing Equipment Downtime through Low-cost IoT Migration

**Issues**

- Unable to achieve traceability, making improvement and quality control difficult

**Solutions**

- When a fault related to equipment or quality occurs, an alert is sent to a device worn by a worker on the shop floor
- A traceability system was built to automatically record production line information in a database. Furthermore, by utilizing common tools, IoT was also achieved at low-cost

**Equipment downtime reduction**

<table>
<thead>
<tr>
<th>Approx. 25% reduction</th>
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**Benefits**

- Analyses data on machining, quality, etc., and determines how to improve
- Alert sent to wearable device if a fault occurs
- Real-time monitor on the line
- Sends data on machining, quality, etc.
Cases of Use by Other Companies

Promoting paperless operations and centralized control of production information

**Issues**
- Unable to quickly provide answers regarding delivery dates due to paper-based information-sharing, therefore lose potential business
- Many foreign-national employees, therefore need to show clear numbers to achieve accurate operations
- Difficult to identify causal factors of rejects

**Measure**
- Systemization of production planning and connection to sales management system
- Collection of shop floor data with a PLC and handy terminal

**Results**
- Able to confirm everything in the system from delivery date response to production and shipment
- Automatic recording/sharing of performance in numerical form
- Identify causal factors through traceability connecting information on products and individual processes

Advancing smart manufacturing at the Yukimi Daifuku Plant – Aiming for “fully autonomous operation”

**Issues**
- The company intended to create a smart factory leveraging IoT and AI amidst a future outlook of labor shortages, etc. due to lack of human resources, retirement of skilled workers, etc.

**Measure**
- Introduced MELPIC industrial computer and Edgecross-compatible Real-Time Data Analyzer software

**Results**
- Achieved consistent quality by collecting and analyzing data that determines the quality of mochi
- Achieves low-cost preventive maintenance of equipment through vibration analysis of mochi hopper
- Enables monitoring of entire line by linking data with control devices

Achieve traceability with detailed history management as a foothold to stronger global expansion

**Issues**
- Product traceability including machining history
- Visualization utilizing IoT

**Measure**
- Introduction of traceability system, Traceabia, and Miranda VR, which collect production shop floor data

**Results**
- Speedy identification of causes for faults
- Understand energy usage down to detailed unit of measurement
- Obtain important insight for strengthening global expansion
Leveraging IoT to Realize Cylinder Monitoring and Improve Cycle Time

**Issues**
- The company wanted to improve productivity to deal with higher ingredients costs
- Continuous operation leads to lower equipment performance, which then results in a drop in production speed

**Measure**
- Built a cylinder monitoring system with the e-F@ctory Starter Package

**Results**
- Leveraged IoT to monitor operating speed of the air cylinder, which was the cause of reduced production capability
- Achieved at low cost by utilizing the sample program of the e-F@ctory Starter Package
- Improved productivity to exceed initial expectations, bringing positive effects to work style

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FA Devices Linked with Cloud Realizes 24/7 Around-the-Clock Stable Operation of Logistics System

**Issues**
- The company wanted to create a non-stop logistics system in order to efficiently deliver products to customers
- They wanted a solution to immediately discover warehouse errors and swiftly recover

**Measure**
- The MELSEC iQ-R PLC, which is connected to the industrial open network through CC-Link IE, collects and leverages operating information accumulated in the AWS cloud

**Results**
- Achieved 24/7 around-the-clock stable operation with high reliability and swift processing capability
- Visualized real-time operating data by gathering information in the cloud
- Detects device trouble in advance

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Remote Monitoring of Equipment Achieved with Remote Service

**Issues**
- The company wanted to constantly check equipment operating status
- They wanted to swiftly identify/correct equipment trouble and improve operating rate

**Measure**
- Introduced iQ Care Remote4U, achieving equipment and production status control

**Results**
- Use of remote service function made it possible to understand equipment operating status, even from an off-site location
- By understanding trends in machining-related issues, trouble can be prevented and operating rate improved
COMPONENTS
Introduction of Core Products/Technologies

The new e-F@ctory enables connectivity with an even higher number of devices and networks.
e-F@ctory goes beyond the barriers of companies and standards to connect a wide variety of devices and equipment to each other to make innovative monozukuri possible.

Introduction of Core Products/Technologies

Compact and Modular
Controllers
FA sensors
Inverters, Servos and Motors
Visualisation: HMIs
Robots: SCARA, Articulated arm
Numerical Control (NC)
Low voltage: MCCB, MCB, ACB
Power monitoring, energy management

Power/environment peripheral devices
Processing machines: EDM, Lasers, IDS

Mitsubishi Electric SCADA Software
Industrial PC
MES interface products
Controller
Starter Package

Since 2003

Edge Computing Products

Data primary processing/analysis
Data handling

ERP
CAD/CAM
Simulator
SCM
MES
SCADA

Supply chain
Procurement
Product design
Process design
Production
Sales and distribution
Operation and maintenance

Engineering chain
Sales and distribution
Operation and maintenance
Product design
Process design
Production
Engineering chain

Manufacturing Execution System (MES)
Supervisory Control and Data Acquisition (SCADA)

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Introduction of Core Products/Technologies

The Advanced Products, Software and Networks Behind e-F@ctory

The new e-F@ctory enables connectivity with an even higher number of devices and networks. e-F@ctory goes beyond the barriers of companies and standards to connect a wide variety of devices and equipment to each other to make innovative monozukuri possible.

**IT System/Software**

Mitsubishi Electric SCADA Software

**GENESIS 64**

**Edge Computing/Products**

- Industrial PC
- C Controller
- MES interface products

**Shop Floor/Solutions**

- Compact and Modular Controllers
- FA sensors
- Inverters, Servos and Motors
- Visualisation: HMIs

- Numerical Control (NC)
- Robots: SCARA, Articulated arm
- Low voltage: MCCB, MCB, ACB
- Power monitoring, energy management

- Power/environment peripheral devices
- Processing machines: EDM, Lasers, IDS

**Software**

- iQ Edge
- e-F@ctory Starter Package
- CC-Link IE TSN
- iQ Platform
- Remote 4U
Suited to the two applications of “real-time control” for control of devices, and “edge computing” to collect and analyze data in the edge layer. The extensive lineup features everything from high-end to low-range models, and contributes to improvements on the production shop floor through data utilization.

**MI5000**
- Equipped with Windows® and VxWorks®, integrates device control and information processing into one module
- High-accuracy device control with CC-Link IE Field Network

**MI3000/MI2000/MI1000**
- MI3000: Able to display and operate data collected
- MI3000/MI2000: Able to accumulate data analysis and large-capacity data
- MI1000: Computer functions in a compact size

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**Edgecross-compatible Software**

- **Data analysis/diagnosis software**
  - Enables offline analysis and real-time diagnosis of a wide variety of data from the shop floor.
  - AI Maisart® waveform recognition technology makes it possible to learn/recognize the sensor current wavelengths of devices.
  - Enables detection of faults within the system with easy-to-use statistical methods such as the Mahalanobis-Taguchi method and multiple regression analysis.

  *Abbreviation of Mitsubishi Electric’s AI creates the State-of-the-ART in technology.

- **GOT2000-compatible HMI Software**
  - GT SoftGOT2000
    - Able to use GOT2000 functions on a computer
    - Able to reuse screen data from the GOT2000 Series
    - Interconnectivity with other applications

- **Mitsubishi Electric SCADA software**
  - GENESIS64™
    - Enables monitoring of a wide variety of data from the shop floor
    - Enables remote monitoring with 3D display and other forms of advanced visuals and web browser/mobile devices

- **Energy-saving Analysis and Diagnostic Applications**
  - EcoAdviser
    - In addition to the imaging of collected energy data, effective energy-saving activities can be made by extracting energy loss by AI and diagnosing factors.
MES Interface Products - Use databases without computers or programs

**MELSEC iQ-R/MELSEC-Q Series PLC MES Interface Module**

Directly connects PLCs and databases without using gateway computer or communication program.

- Directly transmits information collected from the production shop floor to a database.
- High-speed transmission of manufacturing results and receipt of recipe information.
- Optimal for building traceability systems.

**Computerized Numerical Controller (CNC) M800/M80 Series MES Interface Function**

CNC sends machining information and operation status of machine tools to MES.

- Enhances traceability and supports visualization of the entire factory.
- When machining is complete, etc., the information collected by the CNC is sent from the built-in MES interface to the database.
- Achieves visualization of operation status, as well as the visualization of machining results and alarm occurrence status.

**GOT2000 HMI MES Interface Function Graphic Operation Terminal**

The GOT2000 HMI collects and sends data to the MES from FA products connected to it.

- Collects data from existing equipment and other equipment that utilize third-party PLCs.
- Supports operators’ tasks by providing access to a barcode reader, document viewer, or other such tools.
- Equipped with substantial information management functions characteristic of a display unit (HMI).

**OPC UA Built-in Servers - Building secure systems**

**MELSEC iQ Series OPC UA Server Module**

Simply setup using OPC UA communications.

- When designing manufacturing devices, it is possible to internally store and manage the data that is to be released using tag names and layered structures.
- OPC UA security functions can be set optionally on an as needed basis.
- Intuitive operation possible using a Wizard format and setup screen selection format.

**High-Speed Logging of Shop Floor Information**

**MELSEC iQ-R/MELSEC-Q Series High-speed Data Logger Module**

Data logging synchronized with PLC scans.

- Swift problem-solving when trouble arises.
- Contributes to operational analysis, trend analysis and preventive maintenance of devices.

**BOX Data Logger**

- Easy, computer-free logging of equipment data.
- Automatic creation of ledgers and reports in Excel® files.
- Able to install stand-alone type on existing equipment at a later stage.

**Performing Control, Information Processing and Host Communication Process with a C/C++ Programs**

**MELSEC iQ-R/MELSEC-Q Series C Controller Module**

Easy programming independent of the microprocessor.

- Parameter settings, diagnosis and monitoring with CW Configurator.
- Easy application development.

**MELSEC iQ-R Series C Intelligent Function Module**

- C/C++ supports complicated computation processing.
- Easy application development.
- Optimal for usage even in clean rooms which must be kept dust-free.
Open integrated network connecting the production shop floor and IT systems

CC-Link IE TSN is a network achieving seamless communication using TSN technology and innovative communication protocols to collect data from various devices on the shop floor in real time and transmit it to IT systems, thereby creating new added value.

Performance

In today’s production shop floor environments, there is a need to improve productivity and quality. As such, it is essential to have a network that can utilize AI and preventive maintenance to transmit high volumes of data to IT systems while performing high-speed, stable control. CC-Link IE TSN uses an updated communication method to achieve significantly improved communication performance, therefore enabling high-accuracy motion control in addition to high-speed I/O control.

Intelligence

In industrial communications, to reduce overall cost, there is a need for intelligent networks that contribute to easy system construction and maintenance. CC-Link IE TSN supports various convenient functions such as automatic generation of system configuration diagrams and batch distribution of network parameters, thereby significantly reducing system development costs and maintenance costs.

Connectivity

In order to achieve monozukuri at a more advanced level, there is a need for networks that can connect to various devices at the same time as securing real-time performance. CC-Link IE TSN makes it possible to combine general-purpose Ethernet communication and control communication, and connect to general-purpose Ethernet devices without impacting control communication. Furthermore, it is possible to build a network compatible with various topologies; therefore, flexible IIoT systems can be built.

e-F@ctory Starter Package

The e-F@ctory Starter Package is a sample project for MELSEC iQ-R Series PLCs and GOT2000 Series HMIs. It shows how easy it is to achieve the low-cost implementation of IoT (easy data analysis, visualization, etc.) at the production shop floor level.

Utilization of IoT on the Shop Floor

Applying IoT technologies to the manufacturing industry, production equipment status, product manufacturing status and product quality status can all be understood in real-time, thus making it easy to provide feedback to equipment and workers, and achieve ongoing cost reduction throughout the entire production shop floor.

Supporting Implementation of IoT at the Production Shop Floor Level

Because programs for visualization, easy analysis, and other functions are provided in a sample project format, implementing IoT at the production shop floor level can be accomplished using only basic configurations such as device allocation and parameter settings.

Various Functions Incorporated

The e-F@ctory Starter Package incorporates various functions to implement IoT for production shop floor data through visualization, easy analysis, and other means, and can be easily matched for use with customers’ applications.

Achieving IoT with Minimal Impact on Existing Equipment

By adding a PLC and HMI embedded with the e-F@ctory Starter Package, it is easy to implement IoT on the production shop floor with minimal impact on existing equipment.
iQ Monozukuri is a step towards realizing e-F@ctory by merging production shop floors and IT systems via open integrated networks.

The iQ Monozukuri FA application package helps customers find solutions to various monozukuri issues they are confronted with, and is an optimal product with the know-how that makes it possible to introduce, expand, operate and maintain efficient systems.

What iQ Monozukuri Provides
- Lineup of a myriad of applications for each process, application, and piece of equipment
- Monozukuri know-how and ideas cultivated by Mitsubishi Electric and its partners over many years
- System centered on highly reliable Mitsubishi Electric FA products

Production system
(production shop floor)

Processes/Applications
- Production/Process
- Action
- Smart work navigator
- Machine tool loading
- Fence application
- Deburring/Finishing
- Packaging

iQSS (iQ Sensor Solution)

Set sensors, perform maintenance, etc. using a single tool. iQSS helps customers reduce total cost of operation through connectivity between sensors, PLCs, HMIs and engineering environments.

Reducing Overall Cost of Sensor Systems
MELSSENSOR makes it possible to reduce the overall cost of sensor systems, including costs related to design, start-up, operation and maintenance, utilizing automatic sensor detection, address change and tool connectivity functions.
iQ Care Remote4U

This service utilizes IoT to collect and accumulate various information from laser processing and electrical-discharge machines, thereby enabling real-time confirmation and diagnosis from a remote location. It is possible to confirm system faults, or signs thereof, and estimate machining time in real-time using a mobile terminal such as a computer, smartphone, etc.

Remote Diagnosis Function

Connects directly from a terminal installed in a service center to customers’ processing machines for rapid support through remote diagnosis. Supports changes to machining conditions, analysis of alarm content, and provision of preventive maintenance information.

Dashboard Function

Enables confirmation of processing machine operating information in real-time via a computer or smartphone. Collects, accumulates, and performs central management of operating/cost information from multiple units. Contributes to production process improvement and operating cost reduction through visualization-based analysis.

MELSOFT iQ Works

A product integrating individual engineering software with the system management software “MELSOFT Navigator” at the core. Improves system design and programming efficiency and reduces total cost.

System Management Software

MELSOFT Navigator

Software made from a combination of various engineering software for the purpose of system upstream design and connectivity between software.

Programmable Controller Engineering Software

Software that comprehensively supports PLC design and maintenance.

MELSOFT GX Works3

Helps to reduce engineering costs by offering graphical and intuitive operability, simple “selection-based” programming and a diagnosis function enabling troubleshooting to be performed with ease.

MELSOFT GX Works2

Helps to reduce engineering costs by inheriting the programming assets accumulated on GX Developer and pursuing comfortable operability by refining familiar functions.

Other Engineering Software

- Display unit screen preparation software MELSOFT GT Works3
- Motion controller engineering software MELSOFT MT Works2
- Robot engineering software MELSOFT RT ToolBox3 mini*
  * When using product ID of iQ Works, RT ToolBox3 mini (summarized edition) is installed. If RT ToolBox3 [w/simulation function] is needed, please purchase RT ToolBox3 product ID.
- Inverter set-up software MELSOFT FR Configurator2
- C controller set-up software MELSOFT CW Configurator
- Servo set-up software MELSOFT MR Configurator2
iQ Platform

A solution proposed by Mitsubishi Electric that integrates and connects shop floor controllers, HMIs, engineering environments and networks. iQ Platform uses leading technology to integrate and optimize our customers systems in order to reduce costs involved with development, production and maintenance.

Exhaustively solving FA issues from the perspective of TCO

**Controllers & HMIs**

- **Improving productivity and product quality**
  1. Significantly improving total system performance through the high-speed system bus performance of the MELSEC Series.
  2. Equipped with the function block* and label-dedicated memory required for program standardization.
  3. Equipped with an integrated, robust security function.

* Parts work as circuit block that is repeatedly used in sequence programs.

**Networks**

- **Reducing loss with high accuracy and speedy production**
  1. Able to incorporate 1Gbps high-speed communication without loss using CC-Link IE.
  2. Achieving seamless communication of individual devices with SLMP.

**Engineering Environments**

- **Streamlining development, operation and maintenance**
  1. Able to detect large-scale network configuration diagrams from actual equipment.
  2. Achieves mutual parameter reflection between MELSOFT Navigator and individual engineering software.
  3. Automatically tracks device changes in system labels shared by each controller and the HMI.

IT System/Software

**GENESIS64™**

We use data that was not previously visible to help customers improve their business activities. GENESIS64™ is an IoT platform that centrally manages FA and IT data to monitor and analyze various types of data. We provide monitoring and integration solutions optimal for customer needs, such as factory automation, smart building construction, and social infrastructure system establishment.

- **Want to improve efficiency of monitoring and operation tasks**
  - Synchronized monitoring on a single screen when a 3D graphic screen is used.
  - Confirm necessary information together with a multi-monitor, multi-view display function.
  - Transmit information instantly with an email function and new push notification.

- **Want to promote energy savings**
  - Visualization of energy consumption/CO₂ emissions for overall system and individual devices.

- **Want to build a highly reliable system**
  - Duplication of data collection servers (collector) and data storage servers (logger).
  - MC Historian enables prolonged period logging, even for large-volume data.

- **Want to perform wide-range monitoring over multiple plants**
  - Real, wide-range monitoring possible by utilizing map data.
  - Guard customers’ valuable data through safe communications and cloud environments.

- **Want to improve operating rate**
  - Prevent trouble leading to prolonged equipment stoppages.
  - Rapid cause identification by customers through know-how accumulation.

- **Want to improve the efficiency of equipment operation**
  - Improve system operations by centrally managing and making data visible.
Collaborating with the partners across the world

SI Partner
Software Partner
Device Partner

SI Partner
Software Partner
Device Partner

Broad knowledge and skill as a comprehensive FA manufacturer

Know-how of all fields relating to monozukuri

Customer

Co-creation

Giving customers back the values born from co-creation

PARTNERS

Partners

Producing entire production systems
Achieving advanced systems integration
Development of application software strengthening connection affinity with Mitsubishi Electric FA devices
Provide device compatibility with Mitsubishi Electric FA equipment
Achieve improved system builds and maintainability

e-F@ctory Ecosystem – Co-creation with over 1,000 Partners*

As a solutions provider, we collaborate with many partners across all monozukuri fields. This ecosystem provides optimal solutions in various regions and fields in response to the issues experienced by our customers.

*As of September 2021
e-F@ctory Alliance

**e-F@ctory Ecosystem – Co-creation with over 1,000 Partners***

As a solutions provider, we collaborate with many partners across all monozukuri fields. This ecosystem provides optimal solutions in various regions and fields in response to the issues experienced by our customers.

*As of September 2021

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### Producing entire production systems
Achieving advanced systems integration

- IT
- Production shop floor
- Robots

### Development of application software strengthening connection affinity with Mitsubishi Electric FA devices

- ERP/MES/SCADA
- CAD/CAM/3D simulator
- Data analysis

### Provide device compatibility with Mitsubishi Electric FA equipment
Achieve improved system builds and maintainability

- Sensors
- RFID
- Related network devices

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*Alliance*
Factory Automation Global website

Mitsubishi Electric Factory Automation provides a mix of services to support its customers worldwide. A consolidated global website is the main portal, offering a selection of support tools and a window to its local Mitsubishi Electric sales and support network.

- From here you can find:
  - Overview of available factory automation products
  - Library of downloadable literature
  - Support tools such as online e-learning courses, terminology dictionary, etc.
  - Global sales and service network portal
  - Latest news related to Mitsubishi Electric factory automation

Mitsubishi Electric Factory Automation
Global website:
www.MitsubishiElectric.com/fa

Online e-learning

An extensive library of e-learning courses covering the factory automation product range has been prepared. Courses from beginner to advanced levels of difficulty are available in various languages.

- Beginner level
  Designed for newcomers to Mitsubishi Electric Factory Automation products gaining a background of the fundamentals and an overview of various products related to the course.

- Basic to Advanced levels
  These courses are designed to provide education at all levels. Various different features are explained with application examples providing an easy and informative resource for in-house company training.

Precautions before use

This publication explains the typical features and functions of the products herein and does not provide restrictions or other information related to usage and module combinations. Before using the products, always read the product user manuals. Mitsubishi Electric will not be held liable for damage caused by factors found not to be the cause of Mitsubishi Electric; opportunity loss or lost profits caused by faults in Mitsubishi Electric products; damage, secondary damage, or accident compensation, whether foreseeable or not, caused by special factors; damage to products other than Mitsubishi Electric products; or any other duties.

For safe use

- To use the products given in this publication properly, always read the relevant manuals before beginning operation.
- The products have been manufactured as general-purpose parts for general industries, and are not designed or manufactured to be incorporated in a device or system used in purposes related to human life.
- Before using the products for special purposes such as nuclear power, electric power, aerospace, medicine or passenger-carrying vehicles, consult with Mitsubishi Electric.
- The products have been manufactured under strict quality control. However, when installing the products where major accidents or losses could occur if the products fail, install appropriate backup or fail-safe functions in the system.
YOUR SOLUTION PARTNER

Mitsubishi Electric offers a wide range of automation equipment from PLCs and HMIs to CNC and EDM machines.

A NAME TO TRUST

Since its beginnings in 1870, some 45 companies use the Mitsubishi name, covering a spectrum of finance, commerce and industry.

The Mitsubishi brand name is recognized around the world as a symbol of premium quality.

Mitsubishi Electric Corporation, established in 1921, is active in space development, transportation, semi-conductors, energy systems, communications and information processing, audio visual equipment and home electronics, building and energy management and automation systems, and has 183 factories, laboratories and offices worldwide in over 140 countries.

This is why you can rely on Mitsubishi Electric automation solution - because we know first hand about the need for reliable, efficient, easy-to-use automation and control in our own factories.

As one of the world’s leading companies with a global turnover of over 4 trillion Yen (over $40 billion), employing over 146,000 people, Mitsubishi Electric has the resource and the commitment to deliver the ultimate in service and support as well as the best products.

- Low-voltage Power Distribution Products
- Transformers, Med-voltage Distribution Products
- Power Monitoring and Energy Saving Products
- Power (UPS) and Environmental Products
- Compact and Modular Controllers
- Servos, Motors and Inverters
- Visualization: HMIs
- Edge Computing Products
- Numerical Control (NC)
- Collaborative and Industrial Robots
- Processing machines: EDM, Lasers
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