MITSUBISHI ELECTRIC
Changes for the Better

for a greener tomorrow eco Changes

FA-IT Integrated Solution
e-F@ctory

Connect everything

Cases
Products
Alliance

GLOBAL IMPACT OF MITSUBISHI ELECTRIC

Through Mitsubishi Electric's vision, "Changes for the Better" are possible for a brighter future.

Changes for the Better

We bring together the best minds to create the best technologies. At Mitsubishi Electric, we understand that technology is the driving force of change in our lives. By bringing greater comfort to daily life, maximizing the efficiency of businesses and keeping things running across society, we integrate technology and innovation to bring changes for the better.

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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Connect everything

The world's industries are facing a major turning point dubbed as the “Fourth Industrial Revolution”.
In order to survive fierce competition, it is crucial that companies swiftly shift to the Internet of Things (IoT) and optimization, not only on the shop floor, but manufacturing overall.
The FA-IT Integrated Solution e-F@ctory can help to achieve this.

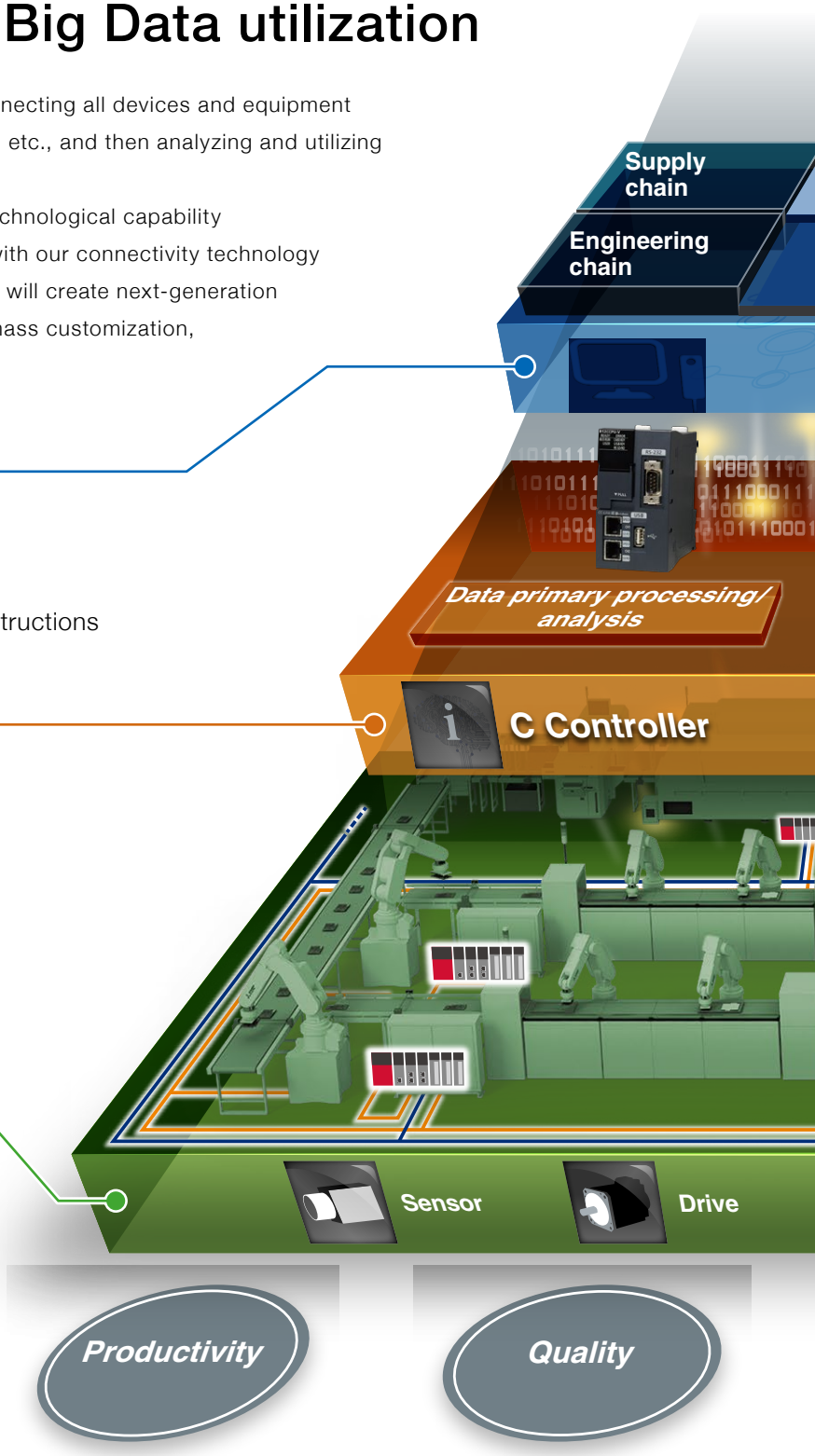
Mitsubishi Electric provides a “one-stop” solution to the digital shift of manufacturing by focusing on “edge computing” which collects/analyses data from the shop floor and uses this to improve manufacturing overall in real-time.
This is possible through broad-based knowledge and technologies unique to a total FA manufacturer and alliances with over 450 partner companies*.

Throughout the world, the e-F@ctory revolution that will connect everything and optimize manufacturing overall has already begun.

*As of October 2017

e-F@ctory creates “Smart Factories” through IoT-based Big Data utilization

e-F@ctory optimizes manufacturing overall by connecting all devices and equipment involved in development, manufacturing, logistics, etc., and then analyzing and utilizing the vast amount of data collected.
By taking full advantage of Mitsubishi Electric’s technological capability that achieved development of FA devices, along with our connectivity technology which makes it possible to connect FA with IT, we will create next-generation manufacturing encompassing elements such as mass customization, preventive maintenance and traceability.



IT systems

- Company operations management
- Data analysis for task improvement
- Production management and execution instructions

Edge computing

- Real-time feedback to shop floor
- Processing and analysis of shop floor data
- FA-IT seamless connectivity

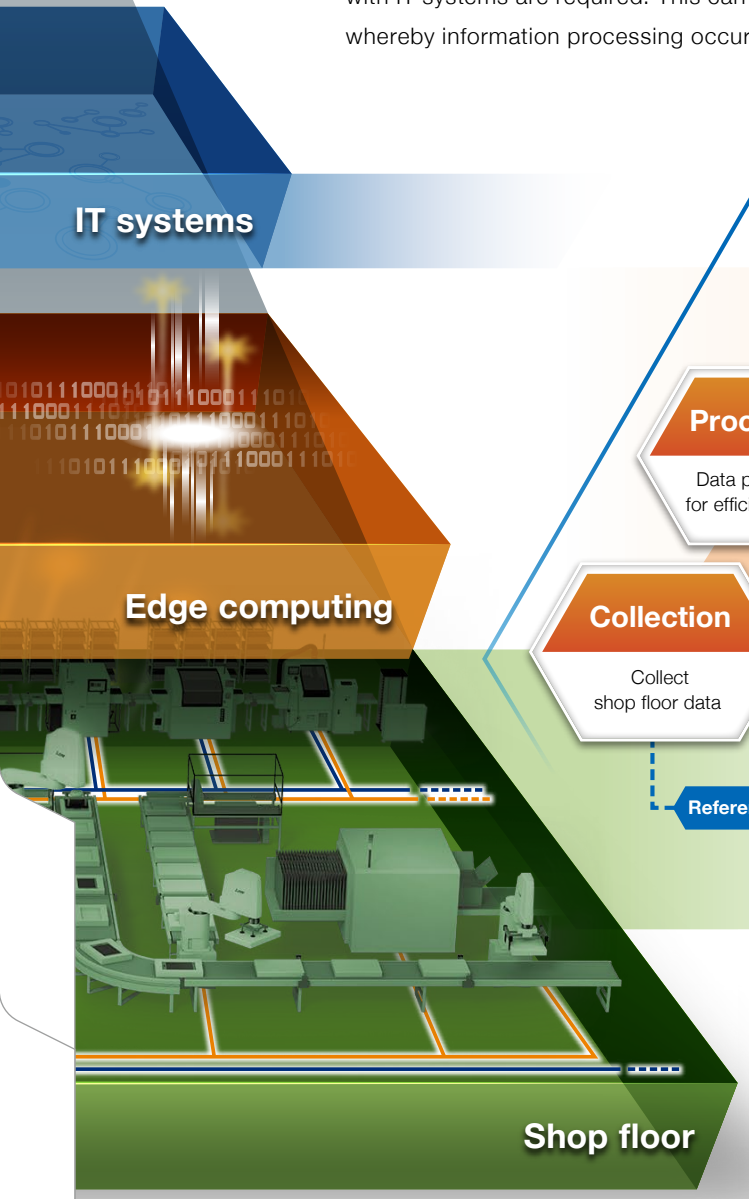
Shop floor

- Production/Equipment data acquisition
- Production execution
- Sensing


e-F@ctory since2003
Procurement
Production
Sales and distribution
Product design
Process design
Operation and maintenance
ERP
SCM
MES
CAD/CAM
Simulator
SCADA
FA-IT Information Interface
Data handling
MES interface
e-F@ctory Alliance
CC-Link IE
Programmable Controller
Mechatronics
Energy-saving
Sustainability
Safety
Security

Processing data on the shop floor and improving manufacturing in real-time

In order to create Smart Factories, real-time utilization of shop floor data and efficient connectivity with IT systems are required. This can be achieved with Edge Computing, a technological concept whereby information processing occurs between the shop floor and IT system.



Offline Analysis

Analysis
Analyze data offline

Processing
Data processing for efficient analysis

Diagnosis
Real-time analysis of results

Real-time diagnosis

Collection
Collect shop floor data

Feedback
Realize preventive maintenance and reduce quality cost

Data Model Management
Hierarchical management of shop floor data

Reference

Reference

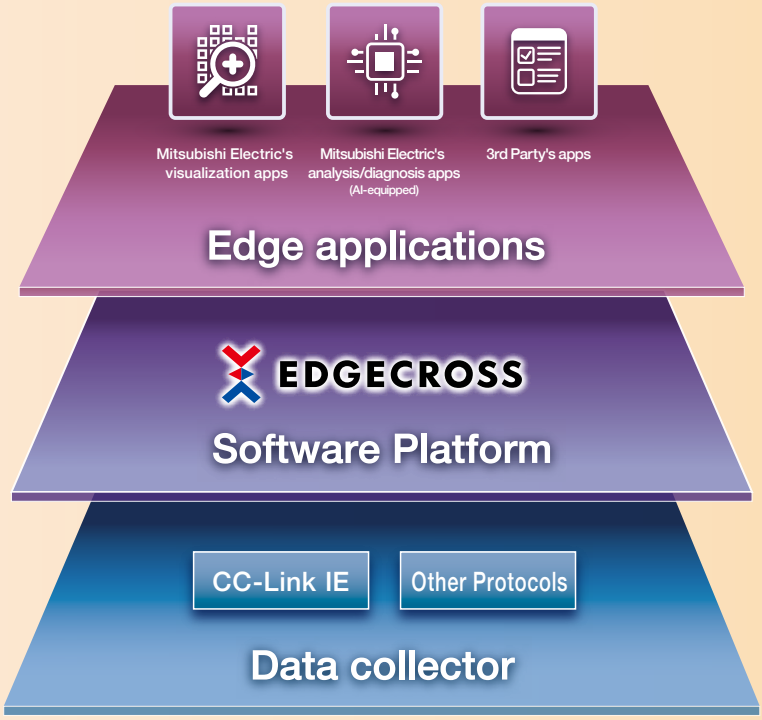
Improving Product Quality and Achieving Preventive Maintenance of Equipment

Preparing diagnosis rules by analyzing various data from the shop floor offline enables real-time diagnosis to improve manufacturing quality and conduct preventive maintenance of equipment.

An Environment Where Manufacturers Participate Freely

EDGECROSS

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

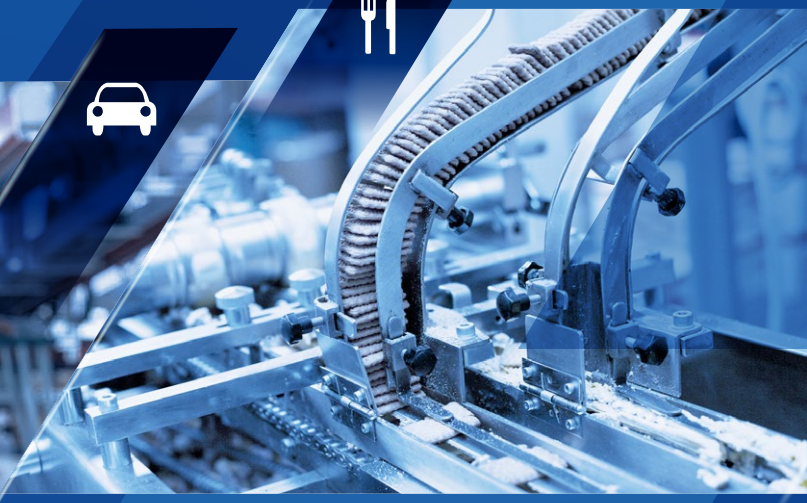
- Regardless of device manufacturer or network, collect various shop floor data
- Collect data from existing facilities

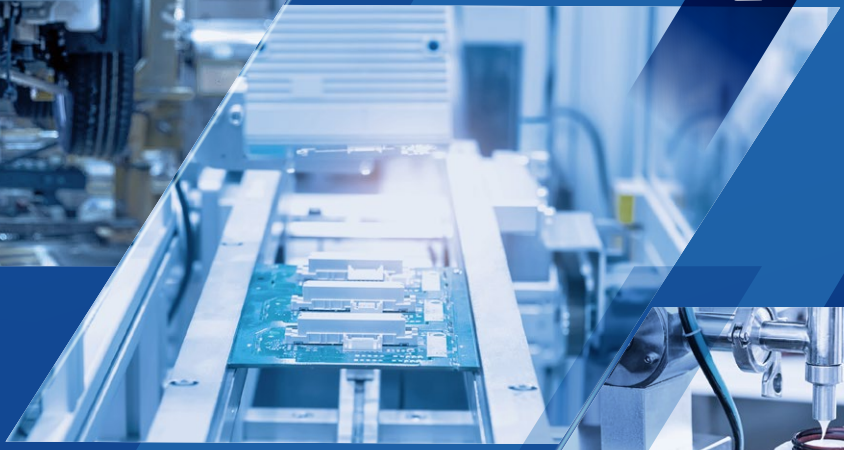
*Edgecross Consortium is an organization for formulating Edgecross specifications and promoting dissemination.

e-F@ctory

CASES

Introduction of Solutions

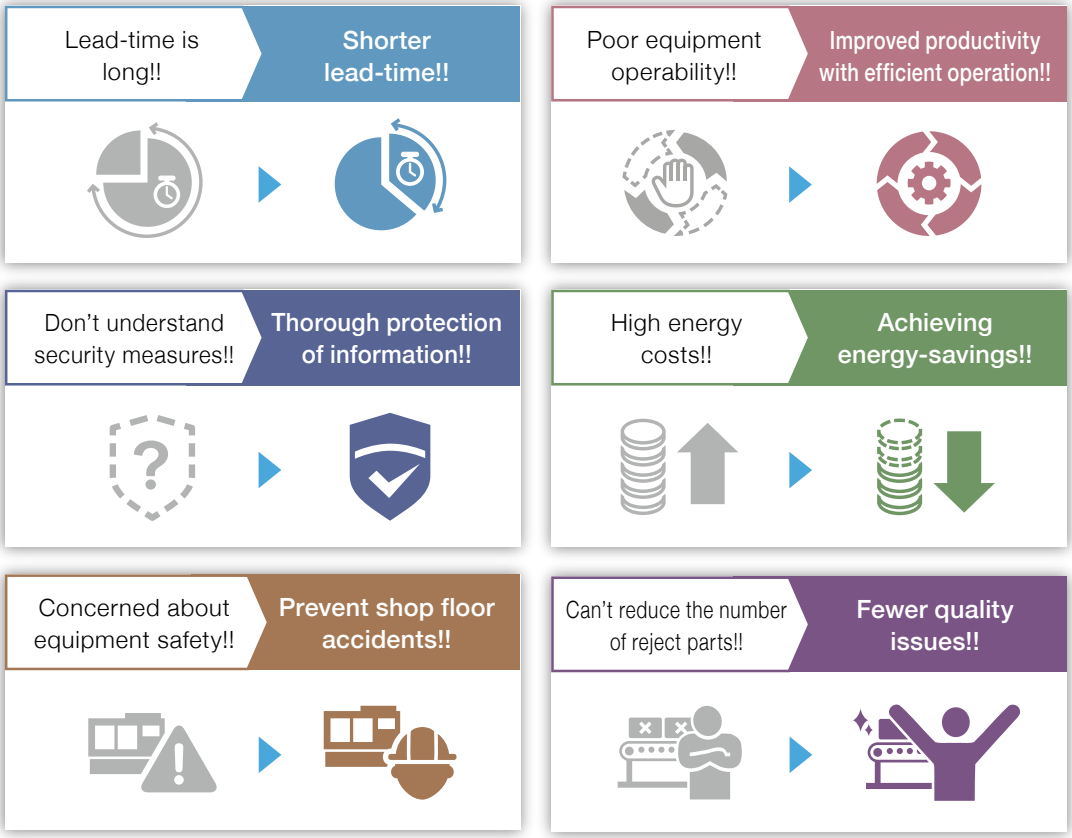




e-F@ctory leverages knowledge accumulated to date to find the optimal solution for each industry type and process.

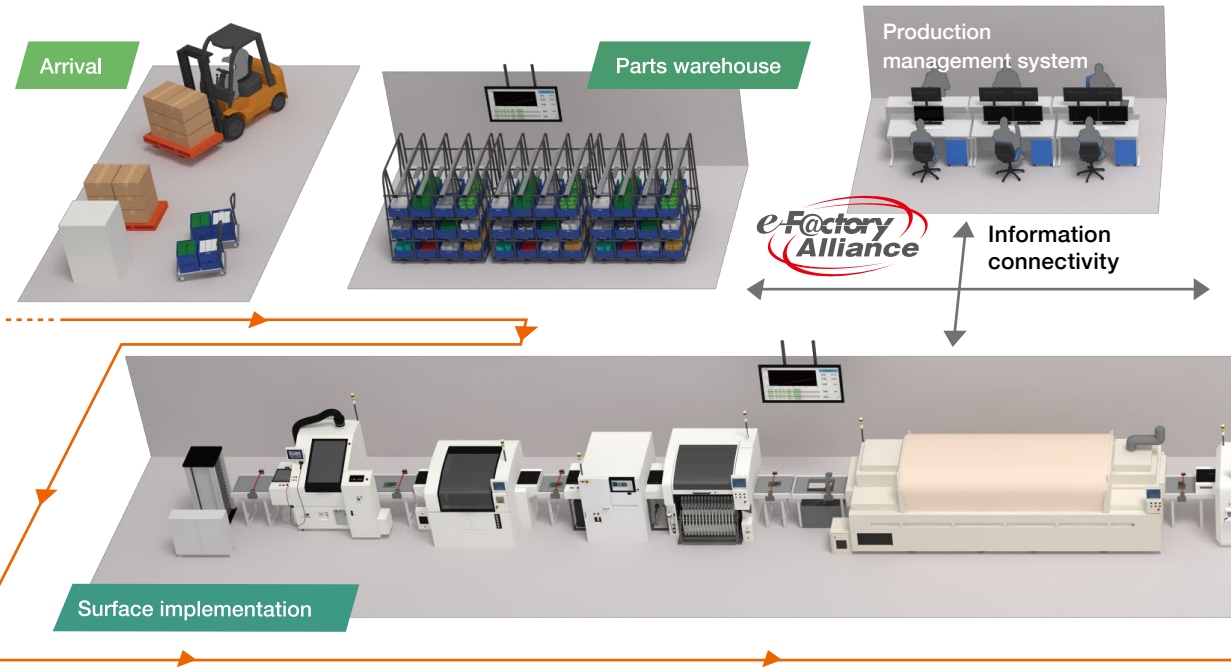
e-F@ctory was launched in 2003 and has helped many companies solve various issues.
From the knowledge accumulated down through the years, e-F@ctory proposes optimal solutions for each industry type and process to achieve productivity and quality improvements, cycle-time reductions, preventive maintenance,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

Issues faced by the manufacturing industry



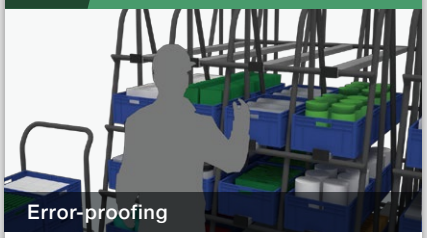
Electricity/Electronic Fields (Compact LCD)

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.



Arrival	Parts warehouse	Surface implementation				PCB assembly	
01	02	03	04	05	06	07	08
Loading	Parts warehouse	Solder printing	Chip mounter	Reflow furnace	Inspection	Primary assembly	Flow-type soldering

02 Parts warehouse



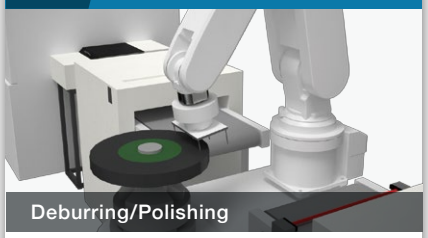
Issues

- Incorrect part selection/supply
- Process stops due to parts shortage

Solution

- Prevent mistakes with a work instruction system
- Advance notification of shortages with a status indicator

11 Deburring/Polishing



Issues

- Complicated adjustments in order to machine workpieces of various shapes
- Tool wear

Solution

- Shorten start-up time with simple teaching
- Detect wear amount with a force sensor

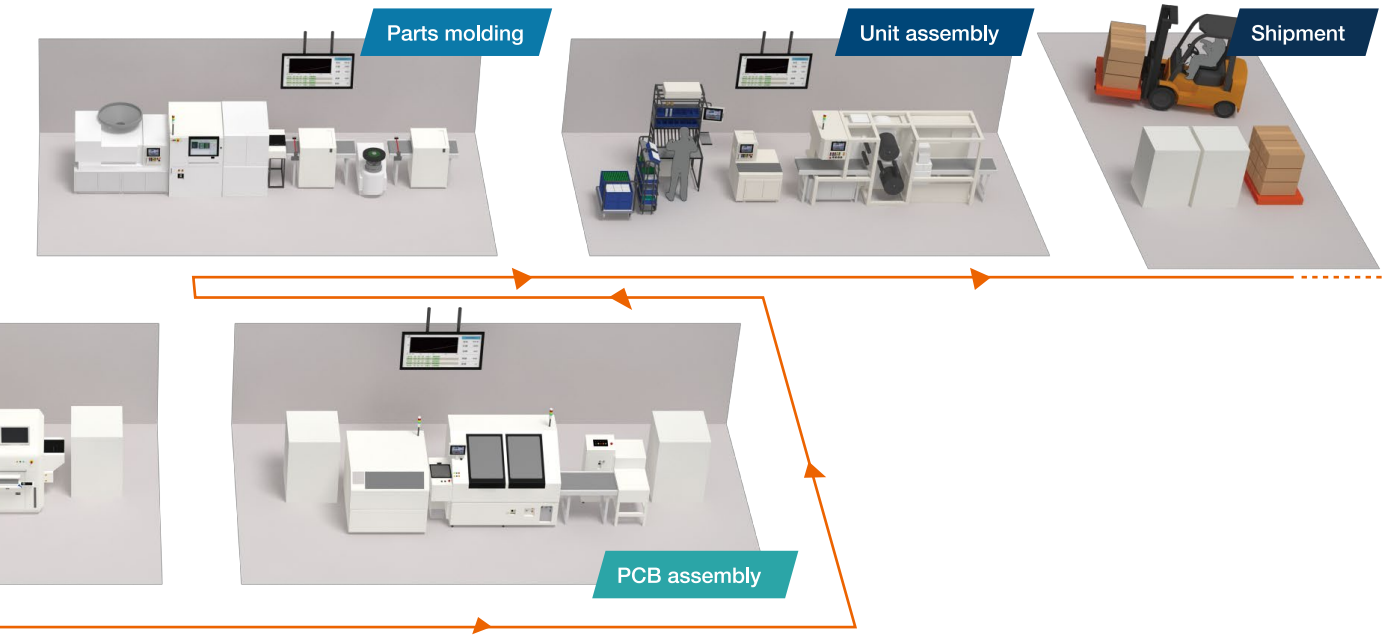
12 Unit assembly

Issues

- Incorrect assembly during high-mix, low-volume production
- Flexible support of production load fluctuations

Solution

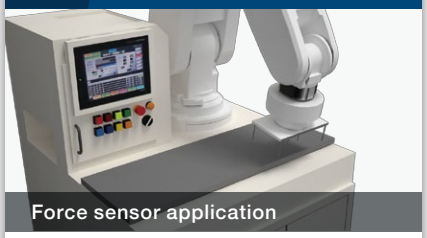
- Prevent mistakes with a work instruction system
- Optimize to suit production status



Parts molding | Unit assembly | Shipment

09 Inspection
10 Injection molding
11 Deburring/ Polishing
12 Unit assembly
13 Inspection
14 Packaging
15 Packing
16 Progress management

13 Inspection



Force sensor application

Issues

- Manual work by humans is required to connect connectors to inspection units

Solution

- Full automation of inspection process through introduction of a robot equipped with a force sensor

14 Packaging

Packaging

Issues

- Seal suited to workpiece, cutting operation and cut length correction necessary

Solution

- Simplification of equipment start-up with a seal/cut mechanism and correction function

16 Progress management

ANDON

Issues

- Visualization of production status is time-consuming and cumbersome
- Can't install status indicators for the sake of visualization alone

Solution

- Able to efficiently build and operate systems not only capable of status visualization on large screens, but also tablets and computers. Features a signage function to improve the added-value of the visualization system

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.

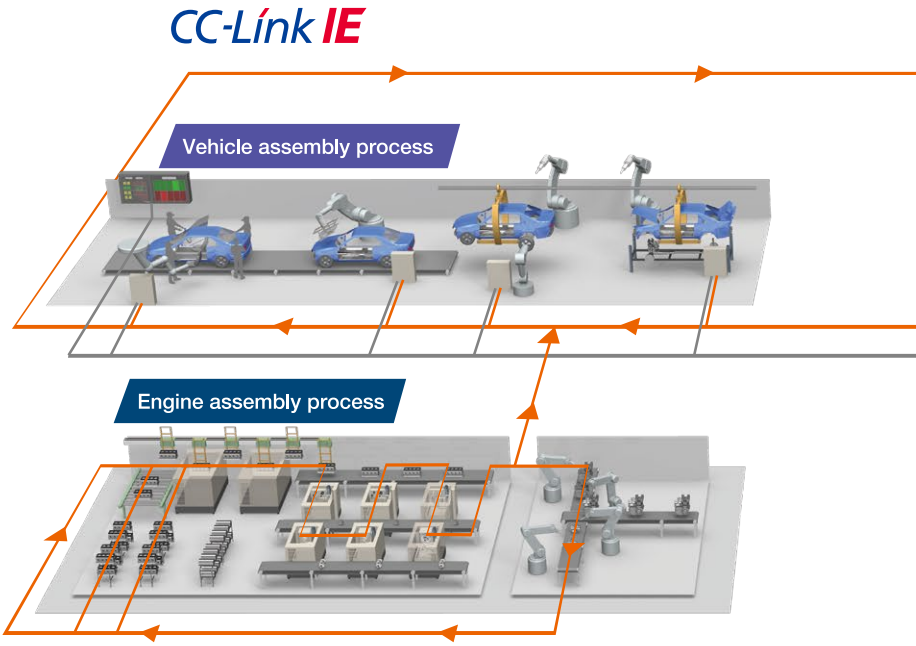
Overall

Issues

- Want to reduce the time it takes for shop floor equipment to recover after a fault has occurred
- Want to easily carry out regular backup of system data for the overall line
- Want to prevent trouble by assessing signs of power abnormalities in equipment

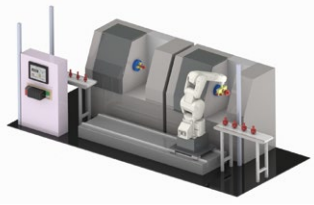
Solution

- GOT backup/System recovery without a computer using a restore function
- Batch backup of all system data with the integration engineering tool
- Prevent sudden breakdowns by constantly monitoring electric current (or electric power)



Stamping process			Welding process				Painting process				Engine assembly process	
01	02	03	04	05	06	07	08	09	10	11	12	13
Coil set	Blanking	Molding (press)	Inner frame welding	Outer join welding	Door welding	Unloading inspection (performed by human operator)	Electro-deposition coating	Sealer application	Finish coating	Paint inspection	Casting	Machining

01 Coil set



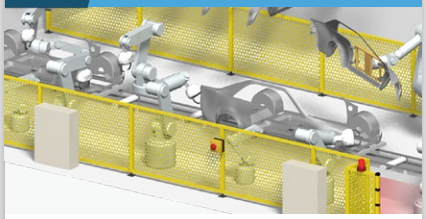
Issues

- Want to perform loading/unloading to/from processing machines automatically
- Concerned about cost of installing a robot
- Want to further improve the productivity of processing machines

Solution

- Installing a robot increases production volume approximately 1.5 times, compensating for equipment depreciation in about one year
- Flexibly supports different product types and production adjustments, and reduces dangerous work (Note: Calculated using Mitsubishi Electric conditions and calculations)

05 Outer join welding



Issues

- Want to ascertain the status of each device in the welding process

Solution

- By installing a PLC, the values of designated devices can be monitored in real-time with arbitrary sensitivity and timing, which leads to preventive maintenance

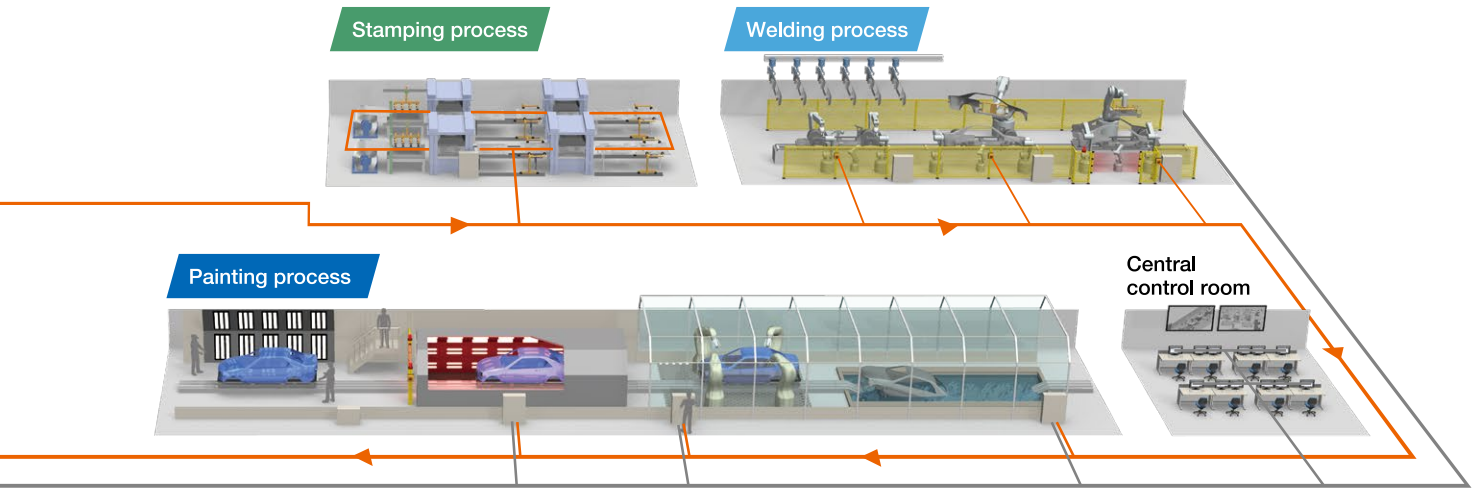
11 Paint inspection

Issues

- In the past, operators inspected accuracy visually and manually. With consideration to mass production, want to shorten time required to inspect each workpiece and eliminate measured value variation due to operators' level of experience

Solution

- The tasks of lot no. scanning, accuracy inspection and measured value recording are all performed automatically, therefore shortening inspection time. Able to perform batch inspection with a sensor jig, therefore creating an inspection system not dependent on operator experience. Reduces manufacturing costs by reducing number of people required for inspection work



Vehicle assembly process

Inspection/shipment processes

14	15	16	17	18	19	20	21	22	23	24	25	26
Heat treatment	Assembly	Instrument panel installation	Glass attachment	Bumper installation	Engine installation	Car seat installation	Tire mounting	Door installation	External inspection	Internal inspection	Other inspections	Shipment

15 Assembly

Issues

- Human error occurs, such as missing a machining step, therefore machining in the wrong order. Want to manufacture products that have passed through the necessary processes with certainty and create a system that can manage process sequence

Solution

- ☑ Through individual management of parts for machining, able to ascertain whether or not parts have been machined in line with the correct process sequence. Workpiece individual management is possible with a laser engraving + barcode reader, and major additional machining is not required

17 Glass attachment

Issues

- Want the coating apparatus to be able to trace the glass surface so that adhesive agent is applied evenly

Solution

- ☑ Correction of nozzle position with a laser displacement sensor

23 External inspection

Issues

- Would like to automate inspection work performed manually and visually by operators
- Would like inspection results to have traceability
- Many man-hours are required to develop programs for sensors

Solution

- ☑ Automation is possible by installing sensors for gap measurement
- ☑ Inspection history can be traced using logging data
- ☑ Less man-hours required for development due to a “single-tool” engineering environment and sample programs

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

Issues

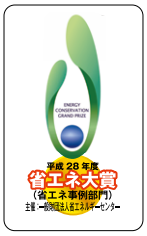
- Stabilization of operating rate by reducing incorrect part implementation
- Shorten time required to analyze failure causes
- Alleviate burden on experienced operators who give instructions
- Safety measures for operators who perform loading/unloading work

Solutions

- **Introduction of a system using a C controller for managing surface implementation**
- **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 MC Works64 and a PLC**
- **Introduction of a vertical conveyance system using a safety PLC**

Benefits

Energy cost	Poor quality	Productivity	Man-hours required to train new employees
Approx. 30% reduction	Approx. 50% reduction	Approx. 30% improvement	Approx. 65% reduction



02 Improving Quality on the Assembly Line

Issues

- Support fluctuating demand and high-mix, varying volume production
- Improve equipment operating rate and quality

Solutions

- **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**

Benefits

Lead-time	Machining time	Poor quality	System build time	Manufacturing timeframe
Approx. 50% reduction	Approx. 40% reduction	Approx. 50% reduction	Approx. 65% reduction	Approx. 50% reduction

* Figures assume calculations without computer and program

03 Improving Productivity with AI Robots

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

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

04 Improving Productivity of the Camshaft Machining Line

Issues

- Improve line balance by shortening grinding time on bottleneck processes

Solutions

- **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

Machining time	Productivity
Approx. 15% reduction	Approx. 30% improvement

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

Issues

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.

Solutions

- 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

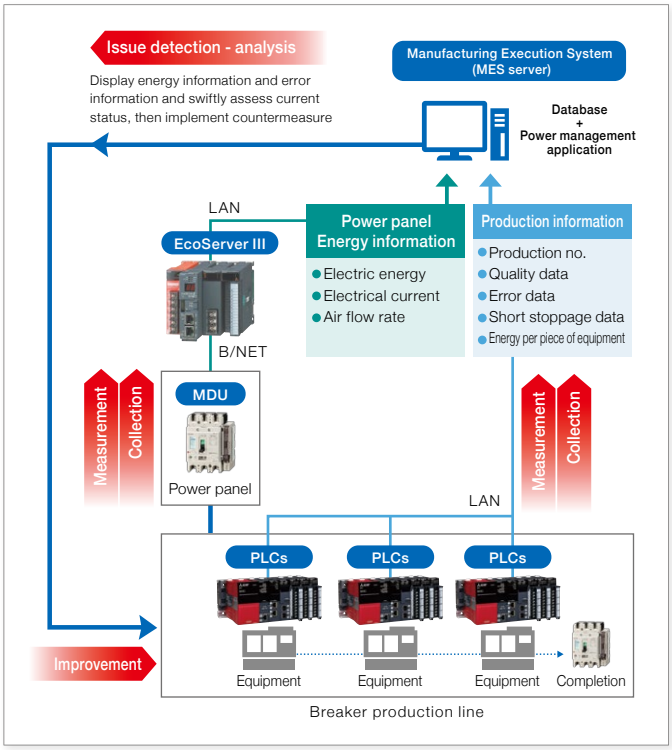
Benefits

Short stoppage occurrence

Approx. 75% reduction

Operating rate

Approx. 50% reduction



02 Energy-savings with Demand Management

Issues

Management and control of General Administration Building power demand

Solutions

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

Benefits

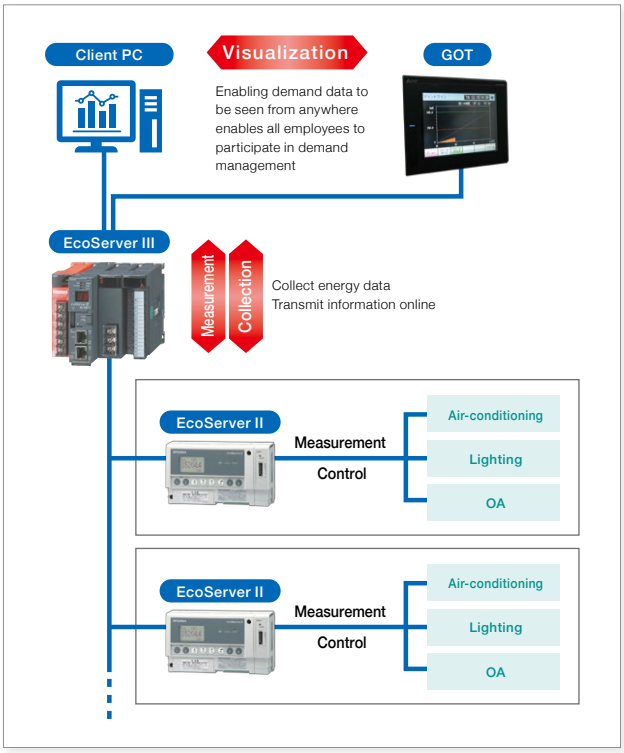
General Administration Building

24% less energy consumption

Fukuyama Works overall

Approx. 100 million yen annual reduction in costs

(base year: 1996, FY2010 results)



03 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

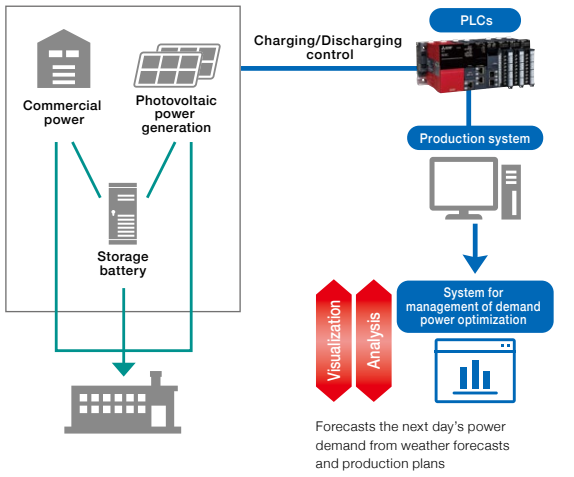
Air-conditioning/lighting Annual power consumption

Approx. **20%** reduction

In monetary value

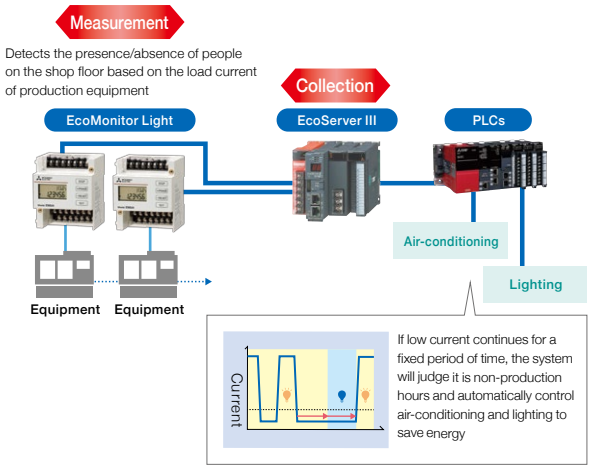
Achieve/maintain a reduction of approx. **500,000yen**

Demand peak shift



Forecasts the next day's power demand from weather forecasts and production plans

Air-conditioning/Lighting control



Streamlining Operation Management Efficiency Through Visualization of Production and Safety

company Honda Motors

Issue When selecting networks for new factories, want to achieve the concentrated visualization of FA control devices and build a safety signal network able to flexibly support line changes.

Measure Introduction of the CC-Link IE field network

Results
- ☑ Built a simple yet robust network suitable for a mother plant
- ☑ Achieved visualization of FA control devices and streamlining operational management tasks and maintenance
- ☑ Communicating safety information in the network, made flexible expansion and changes possible

A Quality Control System That Thoroughly Recognizes the “Individuality” of Products

company Mitsubishi Motors

Issue
- ☐ Even if the overall trend can be assessed, the status of individual products cannot be assessed in real-time
- ☐ Even if faulty products are found, it is difficult to accurately trace back through production processes
- ☐ Specialized knowledge and enormous effort is needed to change programs
- ☐ If problems arise with communications, the production line needs to be changed

Measure Centralized management of each product’s production history with a quality control system adopting an MES Interface

Results
- ☑ Enabled assessment of production processes for individual products as well as change points of products and equipment status
- ☑ Enabled various ways to utilize collected data, such as for productivity improvement/streamlining, etc.
- ☑ Alleviated development costs during extra equipment installations and production line changes
- ☑ Enabled data collection without stopping the line even when communication problems have arisen

Achieving Preventive Maintenance and Securing Safety with Sensor Control

company Omni Yoshida Co., Ltd.

Issue
- ☐ Further improvement of conveyor safety
- ☐ Visualization of 100 pairs of sensors

Measure Introduction of safety PLC “MELSEC-QS” and the AnyWire sensor management solution “AnyWireASLINK” that performs the centralized management of sensors

Results
- ☑ Improved functionality and reliability of securing safety with a PLC + CC-Link IE field network + CC-Link Safety
- ☑ Detects breakdowns without delay using a self-diagnosis safety PLC
- ☑ Centralized management of multiple sensors, enabling preventive maintenance and identification of disconnected wire locations

Centralized Management of Manufacturing Processes All the Way to Shipment

company Itoki Corporation – Chiba Plant

Issue

- ☐ Production level does not supply necessary quantity at the necessary time
- ☐ Manufacturing instructions are done via a paper ledger, which is time-consuming and has potential for human error
- ☐ Unable to accurately assess manufacturing results
- ☐ Unable to connect with other systems such as the production management system and installation management system, so cannot respond to future net sales expansion and increases in production quantity

Measure

Through the introduction of e-F@ctory, achieved the centralized management of all manufacturing processes, from work instructions and results management to quality information collection and product shipment

Results

- ☑ Automation and streamlining of production through information connectivity between production management, MES and production equipment
- ☑ Automatic collection of manufacturing results enables assessment of manufacturing results in real-time without burdening workers on the shop floor
- ☑ Enabled assessment of manufacturing progress at each process
- ☑ An online configuration lets the necessary people view information at the necessary time

Promoting Energy-savings Through Demand Management and Centralized Meter Reading in Response to Request to Cut Energy Usage by 15%

company Tohoku University

Issue

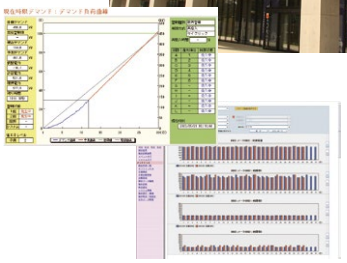
Electricity demand increases due to an increasing student population, respond to request to cut energy usage by 15% following the Great East Japan Earthquake Responded

Measure

Introduction of a system based on Mitsubishi Electric's demand monitoring server "E-Energy," an energy measurement unit and other devices

Results

- ☑ Responding to request to cut energy usage by 15% using demand monitoring following the Great East Japan Earthquake
- ☑ Enabled establishment of countermeasure proposals based on concrete data by assessing the power consumption of each room with centralized meter reading
- ☑ Introduced power visualization for autonomous energy-saving efforts by end-users



Customization of a High-Output Laser Processing Machine to Specialize in Thick Plate and Expand Orders Outside of Usual Range

company Nittetsu

Issue

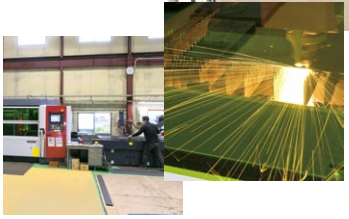
- ☐ Many problems in laser processing machines used in the past and the oscillator (the heart of a processing machine) was also lacking in stability
- ☐ Want to confirm status of processing machines remotely

Measure

Introduction of laser processing machines and remote service "iQ Care Remote4U"

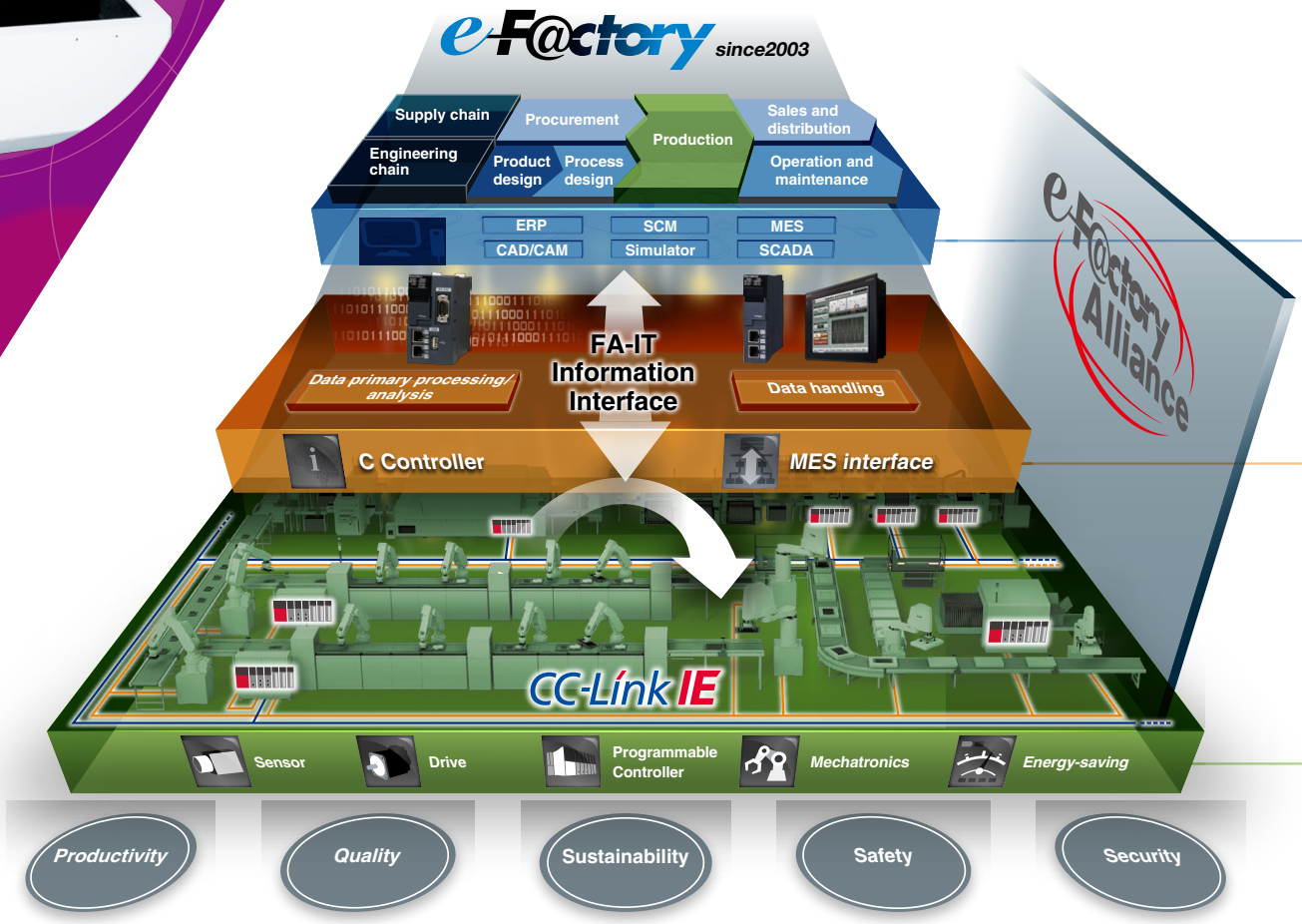
Results

- ☑ Installed a high-output laser processing machine ahead of other companies to become an outstanding company in terms of thick plate processing
- ☑ Accumulated know-how through cooperation with Mitsubishi Electric members
- ☑ Acheived efficient machine management by utilizing a remote service



e-F@ctory COMPONENTS

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

MC Works64

Edge Computing/Products

Industrial PC

MELIPC

C Controller

MELSEC iQ-R series

MES interface products

MELSEC iQ-R series

Making production data beautiful GOT2000 Graphic Operation Terminal

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

CC-Link IE

CC-Link IE Field Basic

iQ Monozukuri

iQSS

iQ Platform

iQ Care Remote 4U

MELSOFT iQ Works

Industrial PC
MELIPC Series

Planned Edgecross support

Realize edge computing that utilizes
a wide range of data from the shop floor.
A large lineup is planned, from advanced models
that enable real-time data processing
using high-performance processors and
CC-Link IE to simple/compact,
low-range models and equipment
for drive-control, etc.

Supporting both control and information processing

Dual-equipped with real-time OS and Windows OS.
Achieves both real-time control/data collection and
information processing.

CC-Link IE data collection

Regular collection of data at the msec-level using
CC-Link IE (collection of data attaching a time stamp
to strictly adhere to the correct chronological order).

**CC-Link is built-in,
making it easy
to build systems.**

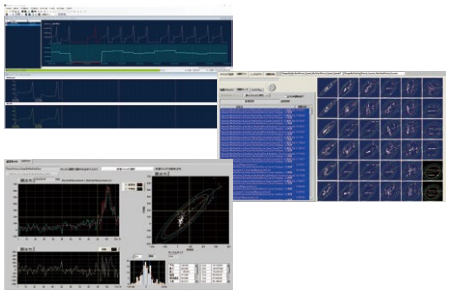
Data analysis/diagnosis software
Real-time Data Analyzer

Maisart

Planned Edgecross support

- 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.



Mitsubishi Electric SCADA software
MC Works64 Edge Computing Edition

MC Works64

Planned Edgecross support

- 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

*Product names may be changed in the future.

MES Interface Products - Use databases without computers or programs

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

PLCs are connected directly to the MES without the use of gateway computers or communication programs.

- Comprehensive plant information are collected and managed via a seamless network.
- Even the most detailed equipment-level information can be collected via an extensive field network.
- Machine tools and equipment that utilize third-party PLCs can be easily configured into the open network.

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.

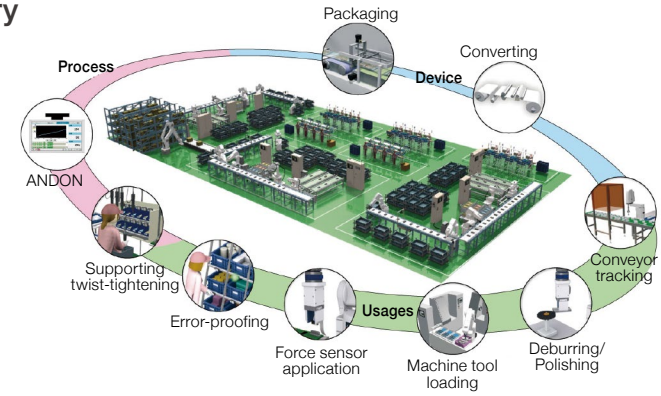
MELSEC iQ-R Series C Intelligent Function Module

- C/C++ supports complicated computation processing.
- Easy application development.
- Optimal for usage even in clean rooms which must be kept dust-free.

Mitsubishi Electric FA Application Package iQ Monozukuri

One solution made available with e-F@ctory
Mitsubishi Electric
FA Application Package System Delivery

iQ Monozukuri is a problem-solving package that considers the respective aspects of the shop floor, namely “process”, “application” and “device”, and maximizes the know-how accumulated by Mitsubishi Electric to date to solve the issues specific to each area.
The package incorporates the elements of “anticipated problems”, “items for implementation” and “implementation means”, and can therefore be adopted by customers quickly and easily.



The Value that iQ Monozukuri Provides

- Design/Procurement: Device selection tool — Prevents failure to procure necessary devices
- Programming: Control program and display unit screen data — Reduces development costs
- Start-up: Setting support tool and dialog-type wizard — Reduces start-up time
- Operation/Maintenance: Business intelligence (BI) tool — Visualizes information on production results and helps increase production efficiency

System delivery
Mitsubishi Electric's FA application package is delivered to customers through the following process.

*Abbreviation of “System Integrator.” Required if the customer will not perform engineering themselves.

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.

MELSENSOR

Reducing Overall Cost of Sensor Systems

MELSENSOR 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

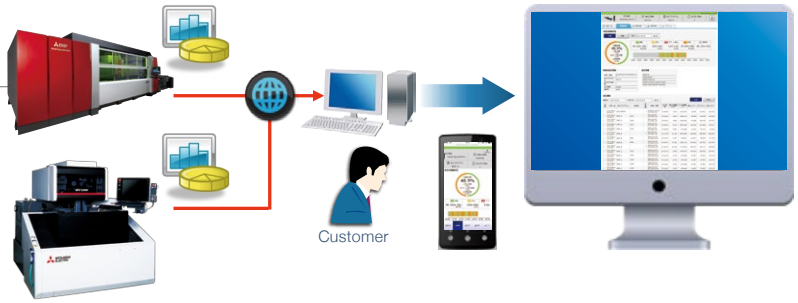
This service utilizes IoT to collect and accumulate various information from laser processing and electrical-discharge machines, thereby enabling real-time confirmation and diagnosis from a remote location. It is possible to confirm system faults, or signs thereof, and estimate machining time in real-time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

Remote Diagnosis Function

Supports customers through connection and remote diagnosis from the Service Center

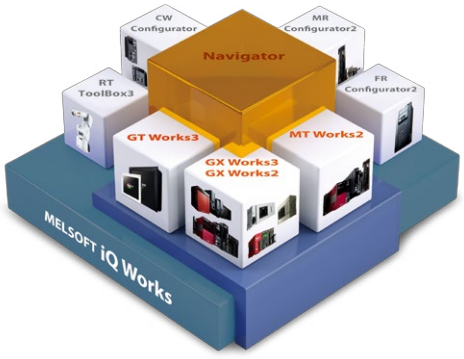
Dashboard Function

Enables the remote confirmation of operational status on a PC, smartphone or tablet



MELSOFT iQ Works

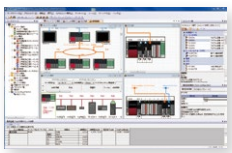
A product integrating individual engineering software with the system management software “MELSOFT Navigator” at the core. Improves system design and programming efficiency and reduces total cost.



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.

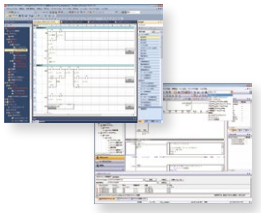


Programmable Controller Engineering Software

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

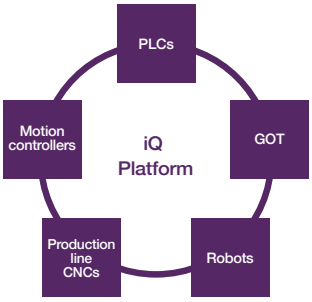
Helps to reduce engineering costs by inheriting the programming assets accumulated on GX Developer and pursuing comfortable operability by refining familiar functions.

Other Engineering Software

- Display unit screen preparation software
  MELSOFT GT Works3
- Motion controller engineering software
  MELSOFT MT Works2
- Robot engineering software
  MELSOFT RT ToolBox3*
  * 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
   * Parts work as circuit block that is repeatedly used in sequence programs.
3. Equipped with an integrated, robust security function

Networks

Reducing loss with high accuracy and speedy production

1. Able to incorporate 1 Gbps 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

CC-Link IE

The backbone of e-F@ctory, the CC-Link IE open network conducts ultrahigh-speed transfer of control data and production data.

Promoting visualization through information alliance

CC-Link IE achieves the real-time data collection necessary for big data analysis by incorporating two key features: SLMP that enables seamless connectivity between IT systems and FA devices; and a high-speed, large-capacity 1 Gbps communications network that enables large volumes of data, such as production, quality and control data, to be transferred in real-time.

General, motion and safety control integrated into one network

CC-Link IE incorporates generic high-speed I/O control and distributed control between controllers, high-accuracy and synchronous motion control, and safety control sharing safety information across multiple safety devices, all on a single network.

Comprehensive diagnosis realizing higher reliability

Disruptions to the system are avoided so that communications are not interrupted even if there is a disconnection in one location by building a network which is highly reliable and resistant to system faults through fiber optic cable with good noise resistance and ring-type wiring. Also, even when unexpected problems arise, network errors can be rectified quickly by displaying the network configuration diagram.

CC-Link IE Field Basic

System configuration in a short period without specialist knowledge

- Supports devices and small-scale equipment previously difficult for networks to support
- Inherits features of CC-Link IE field network*1 and enables easy network settings without specialist Ethernet knowledge with a parameter batch setting function
- Shortens system build time-frame by 40% by automatically setting link device points and addresses*2

Building a network with a high degree of freedom

- By utilizing a general-purpose Ethernet, the host IT system can be connected to devices on the shop floor with a single network cable, which helps to reduce costs
- Possible to build a network with a high degree of freedom thanks to an enriched FA product lineup supporting connectivity with CC-Link IE Field Network Basic

*1 An open field network utilizing 1 Gbps general-purpose Ethernet communication that connects the controller with devices
*2 Compared to the number of parameter settings for Mitsubishi Electric's engineering tools - CC-Link and CC-Link IE Field Network Basic

Mitsubishi Electric is a member of the CC-Link Partner Association (CLPA), the aim of which is the global dissemination of CC-Link IE/CC-Link, an open field network product developed in Japan. Owing to its vigorous activities, the number of the partner manufacturers in Japan and overseas, and the number of CC-Link family connecting products, have continued to increase. Please refer to the CLPA website for details.
www.cc-link.org

MC Works64

MC Works64

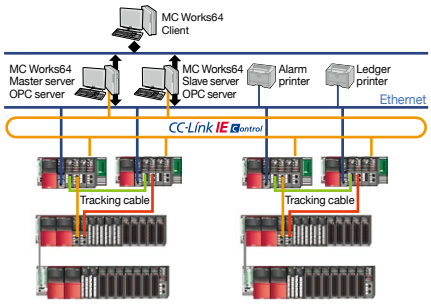
MC Works64 helps to fulfill a vast variety of needs related to monitoring and control, including improvement of visibility and operability, improvement in reliability, reduction of engineering man-hours, visualization of energy and preventive maintenance.

Improved Visibility and Operability

Want to improve the visibility and operability of monitoring operations.

MC Works64 uses a 3D graphics display to improve visibility even for devices which previously had poor visibility with flat 2D graphics display. 3D display enables monitoring from various angles, therefore achieving high-speed and accurate assessment of device status and intuitive monitoring/control operation.

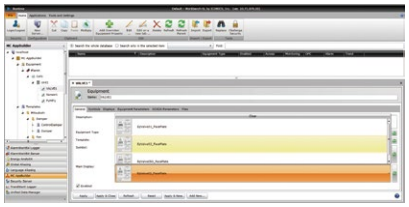
Improved Reliability



Want to build highly-reliable systems capable of continuous operation even if trouble arises.

MC Works64 makes it possible to duplicate servers and build server and client systems. By configuring a system from two servers - one master server and one slave server – the reliability of the system is improved and the network communication load is alleviated. Configurations appropriate to system scale can be created, from large-scale to stand-alone systems.

Reduced Engineering Man-hours



Want to effectively use information in each design list when creating graphic screens and programs.

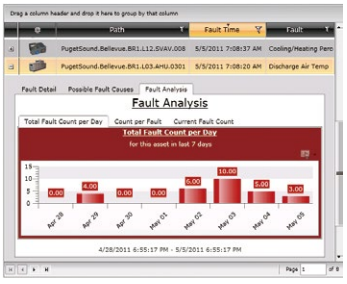
Graphic screens, programs and OPC tag settings are automatically generated from each design list.
A design support tool prevents tag setting mistakes and helps improve design quality. Standard templates assist system builds.

Visualization of Energy

In addition to streamlining plant production, want to reduce energy consumption throughout the plant. Also want to reduce power consumption relating to utilities such as air-conditioning and lighting. Can this be achieved inclusively?

MC Works64 enables the visualization of energy by combining Mitsubishi Electric's energy measurement device and energy display/analysis tool "AX Energy". This helps to reduce energy consumption. With a rich lineup of energy-saving devices including Mitsubishi Electric inverters higher motor control efficiency, plant devices consume less power.

Preventive Maintenance



Want to use the vast amount of data collected to monitor plant devices for preventive maintenance, etc.

The preventive maintenance of equipment is achieved by combining Mitsubishi Electric's MES Interface Module, which collects production management information, with "AX Facility", which displays and analyzes device breakdown and diagnosis information. The operating status of devices is automatically collected from a vast amount of data and used for purposes such as improving operating rate, preventive maintenance and prediction of device breakdowns.

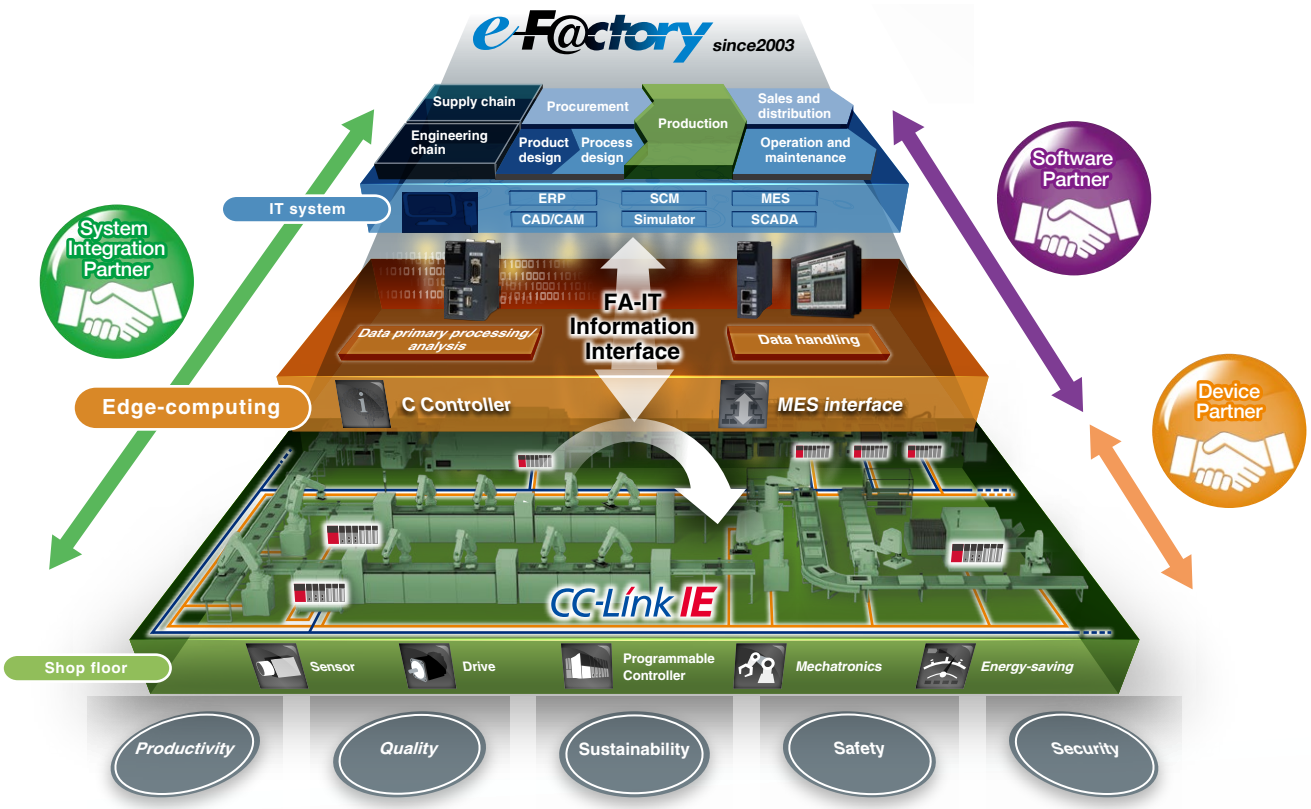
CASES

Alliance Partners

Powerful Alliances with Over 450 Partner Companies*

In order to propose optimal solutions to our customers, e-F@ctory works in collaboration with many partner manufacturers. Through powerful alliances between Mitsubishi Electric, who boasts a broad-ranging product appeal in the FA domain, and partners that participate in the FA partnership program (e-F@ctory Alliance) promoted by Mitsubishi Electric, we will achieve new business creation and new monozukuri never before imaginable.

*As of October 2017



Create entire production systems Realize advanced systems integration

Combining Mitsubishi Electric FA equipment and other products, systems integrators propose systems solutions for everything from shop floors to information systems to customers.

Develop applications software that further enhances the connection compatibility of Mitsubishi Electric FA equipment

Utilizing information-sharing products and technologies such as Mitsubishi Electric's EZSocket and SLMP, vendors develop and propose excellent application software and drivers that ensure the connection compatibility of Mitsubishi Electric FA equipment.

Propose Mitsubishi Electric FA equipment and other machinery with superior compatibility Realize improved systems construction and maintenance

Manufacturers proposing peripheral equipment that is easy to connect with Mitsubishi Electric FA equipment and is easier to use.

Alliance Cases 01 Device Partner Operation/Maintenance

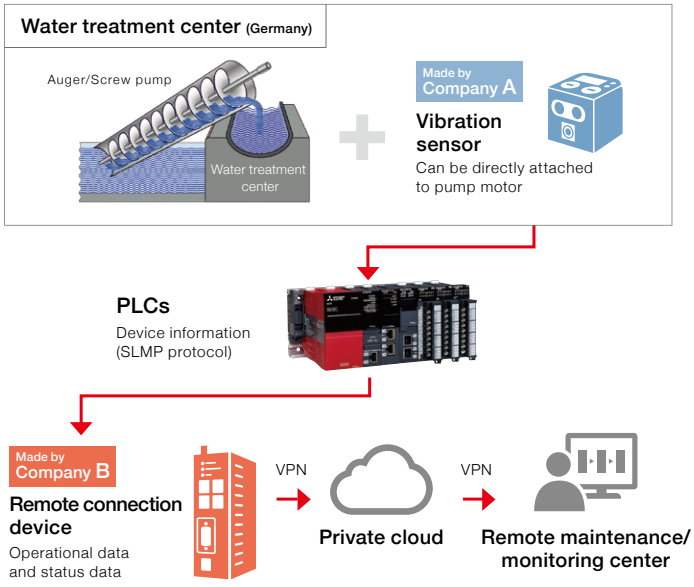
Device Partner

A status monitoring system possible through alliances between Device Partner A, who provides smart vibration sensors, and Device Partner B, who provides remote connectivity.
Discovered flaws in gears four months after installation.

Feature

- ▪ Vibration sensor produced by Company A packaged with PLC
  ▪ Plug & Play realizes easy installation
- Even without expertise knowledge, secure VPN environments can be built using the remote connecting device produced by Company B
- Build scalable status monitoring system in short period of time, and quickly recover short-term investment

Conceptual diagram



Alliance Cases 02 Software Partner Engineering Design/Production/Operation

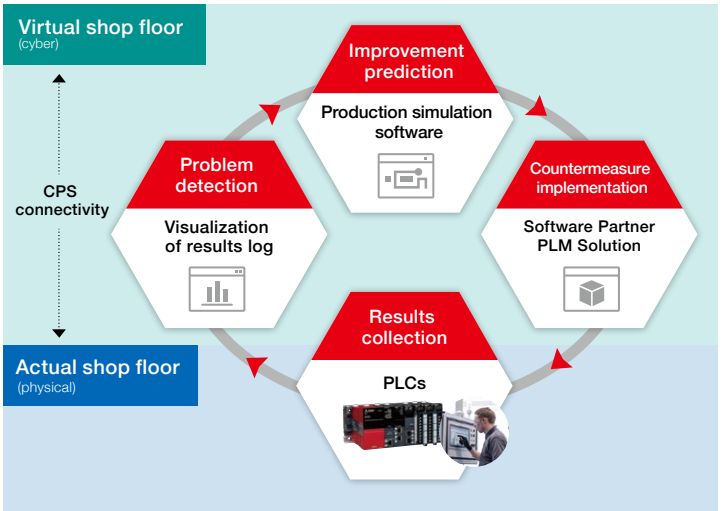
Software Partner

Supporting "Prediction of Improvement Results" by simulating production using "visualization" of shop floor results information collected by the PLC.

Feature

- "Visualization" of shop floor results information collected by the PLC in real-time for the early detection of shop floor issues
- Early detection of the most effective measure by predicting the results of an improvement proposed for a particular issue using production simulation software
- A solution realizing a cyber-physical system enabling shop floor information to be used to improve productivity

Conceptual diagram



Alliance Cases 03 Software Partner Engineering Design

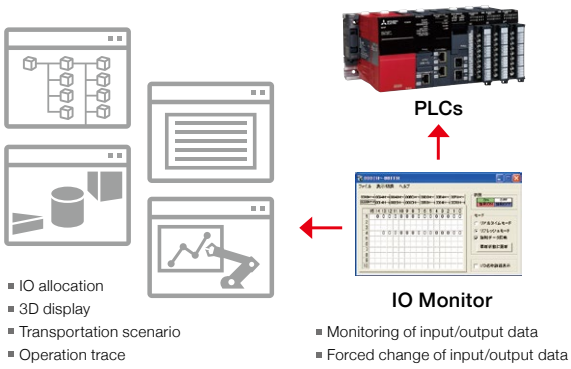
Software Partner

Advance verification of large equipment/device operations using digital mock-up preparation software.

Feature

- Verification with high-speed simulation
  - 3D data high-speed display using a light 3D format
  - High-speed mechanism simulation and dynamic interference check utilizing Multi-Core
- Simulation with high-speed communications possible through a dedicated connection interface with the PLC
- Concurrent development of equipment/ devices possible through connectivity with other software

Conceptual diagram



- IO allocation
- 3D display
- Transportation scenario
- Operation trace

- Monitoring of input/output data
- Forced change of input/output data

Alliance Cases 04 System Integration Partner Operation/Maintenance

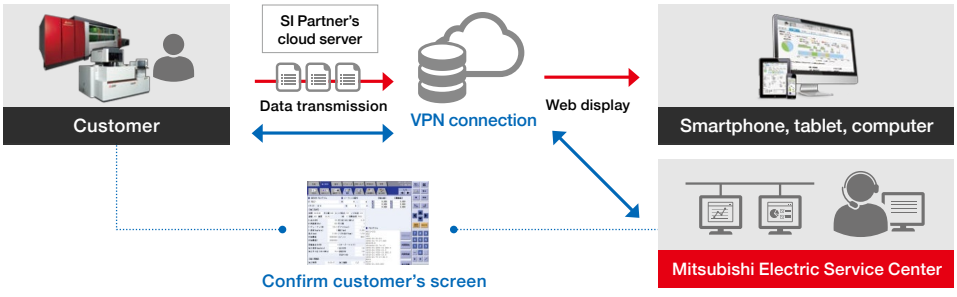
System Integration Partner

Thanks to the support of our partners, we offer a cloud service for the remote status monitoring and remote maintenance of laser processing machines and electrical-discharge machines.

iQCare Remote4U

A remote service supporting the productivity and maintainability of laser processing machines and electrical-discharge machines

- Transfer of machining results and consumable parts information from the processing machine to the cloud server to achieve visualization
- Directly connect and diagnose production equipment remotely during fault occurrence



Dashboard function

- Real-time display of operational information, predicted machining time, etc.
- Collect and accumulate operational results, power/gas consumption, etc.

Contributing to improving production processes and reducing running costs

Improving maintainability with a remote diagnosis function

- Remote diagnosis and preventive maintenance of customer's processing machine from our service center
- Swift response by Mitsubishi Electric personnel when breakdowns occur
- Able to update software versions and change machining conditions from our service center

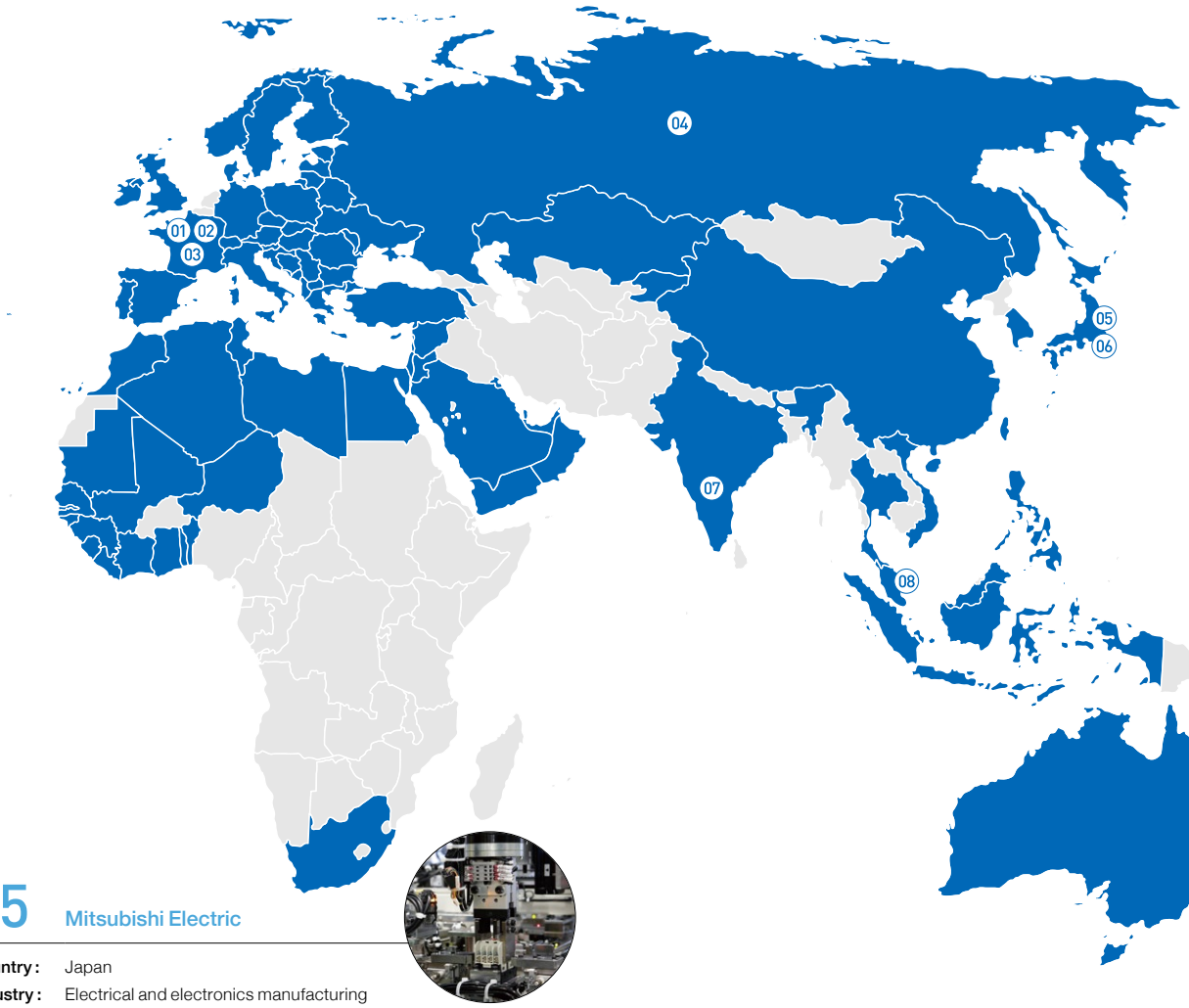
e-F@ctory is offering optimal solutions for issues faced by industry players around the globe and paving the way for new monozukuri potential.

01 Platform Industrie 4.0

Country : Germany
Results : Mitsubishi Electric take part in Working Group 1 part of the German Government project to define future manufacturing strategy for the 4th Industrial revolution.

02 Stadtwerke Rotenburg an der Fulda

Country : Germany
Industry : Waste water treatment
Results : Condition Monitoring System applied to 3 pumps in unmanned treatment station
System cost was recovered after the prevention of two failed drive gearboxs (Ratio of new gearbox cost vs gearbox refurbish cost = 5:1).
20,000 plus local residents experience no inconvenience.



05 Mitsubishi Electric

Country : Japan
Industry : Electrical and electronics manufacturing
Results : Modernization of existing line required to cope with more model variations of small batch size with fast change over.
Operating rate increased 1.6 times, productivity increased 1.3 times, area to productivity ratio increased 2.8 times

06 Nitto Denko Corporation

Country : Japan
Industry : Electronics
Results : Condition Monitoring System applied to old/existing wiring utilizing Earth leakage monitoring to identify critical cabling.
The system increased plant safety, allowed planned maintenance and full compliance to national regulations.

07 Maruti Suzuki

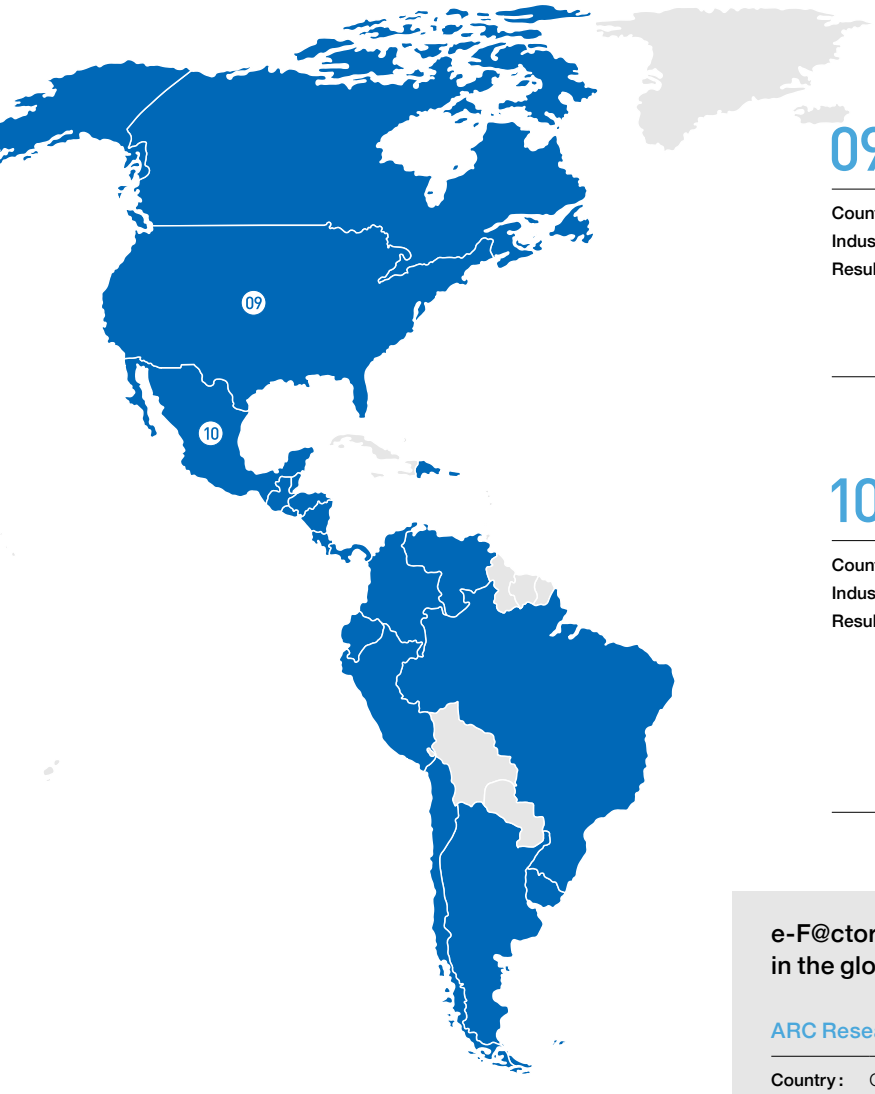
Country : India
Industry : Automotive
Results : High levels of automation required to produce 15 brands or more than 150 varients hence “fool-proofing” is required with full reporting in assembly processes to reduce and manage errors.
Reduction in the number of incorrectly fitted parts and the associated rework costs. Associated network complexity and installation space and costs reduced while maintenance become much easier.

03 Mitsubishi HiTec Paper Europe GmbH

Country: Germany
Industry: Pulp & Paper
Results: Condition Monitoring System applied to 26 critical cooling fans in large paper mill.
System cost was recovered after the prevention of one unplanned stop as machine and product damage was eliminated along with unplanned stoppage and recovery time.

04 Russian Railways

Country: Russia
Industry: Transportation
Results: Reconditioning of thousands of items of rolling stock required complex planning, tracing and tracking.
The automated capture of data at all steps ensured precise records per rolling stock asset; this meant increased safety levels as no assets were missed and reduced asset loss.

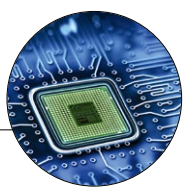


09 IIC Testbed

Country: USA
Industry: Industry market analysts
Results: IIC approved "IoT Testbed for Manufacturers" that was jointly presented with Hitachi and Intel to develop a standardized approach to Factory Automation Platform as a Service (FA PaaS) Testbed.

10 Honda Corporation

Country: Mexico (Japan)
Industry: Automotive
Results: Required a new flexible factory data network concept that would support data, safety and control with flexible topology.
After successful pillot at their model "mother" factory in Yorii, Japan was utilized in their new plant in Mexico.
Benefits include standardised manufacturing concept, shared operational knowledge easier maintenance.



08 Intel Corporation

Country: Malaysia
Industry: Semiconductor
Results: Additional system monitoring to exisiting machinery allowing greater quality control and preemptive action.
After the pilot project Intel estimated future business wide savings of 9m USD.

e-F@ctory has gained a strong reputation in the global market as well.

ARC Research Group

Country: Global
Industry: Industry market analysts
Results: At the beginning of 2016 ARC released a new whitepaper which reviewed the adoption of Smart Manufacturing technologies and highlighted how suitable e-F@ctory was to solving those issues.

Frost and Sullivan

Country: Global
Industry: Industry market analysts
Results: In 2015 Frost and Sullivan recognised Mitsubishi Electric's e-F@ctory concept with an IIoT innovation award.

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.

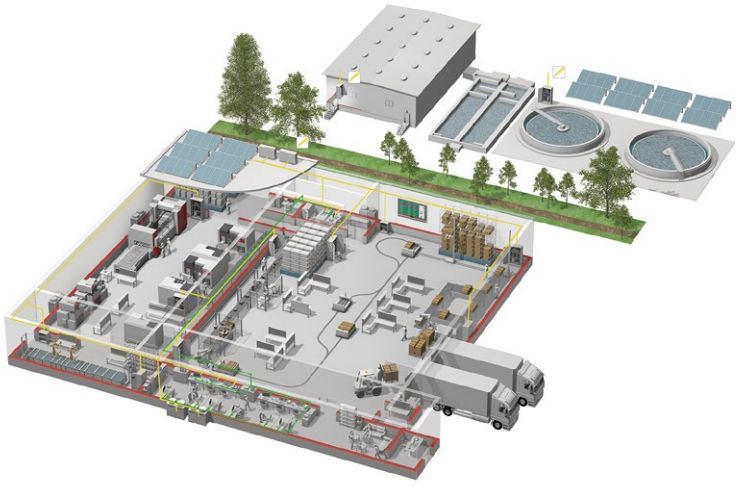
Precautions before use

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 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 237 factories and laboratories worldwide in over 121 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 100,000 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: MCCB, MCB, ACB

Medium voltage: VCB, VCC

Power monitoring, energy management

Compact and Modular Controllers

Inverters, Servos and Motors

Visualisation: HMIs

Numerical Control (NC)

Robots: SCARA, Articulated arm

Processing machines: EDM, Lasers, IDS

Transformers, Air conditioning, Photovoltaic systems

* Not all products are available in all countries.

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Mexico	MITSUBISHI ELECTRIC AUTOMATION, INC. Mexico Branch Mariano Escobedo #69, Col. Zona Industrial, Tlalnepantla Edo. Mexico, C.P. 54030	Tel : +52-55-3067-7500
Brazil	MITSUBISHI ELECTRIC DO BRASIL COMÉRCIO E SERVIÇOS LTDA. Avenida Adelino Cardana, 293, 21 andar, Bethaville, Barueri SP, Brazil	Tel : +55-11-4689-3000 Fax : +55-11-4689-3016
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Mitsubishi Electric Corporation Nagoya Works is a factory certified for ISO 14001 (standards for environmental management systems) and ISO 9001 (standards for quality assurance management systems).

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