for a greener tomorrow

MITSUBISHI ELECTRIC
Changes for the Better

THE ART OF MANUFACTURING

Digitalization in manufacturing to improve your competitiveness

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.

Our advances in AI and IoT are adding new value to society in diverse areas from automation to information systems. The creation of game-changing solutions is helping to transform the world, which is why we are honored to be recognized in the 2019 'Forbes Digital 100' as one of world's most influential digital corporations.

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.

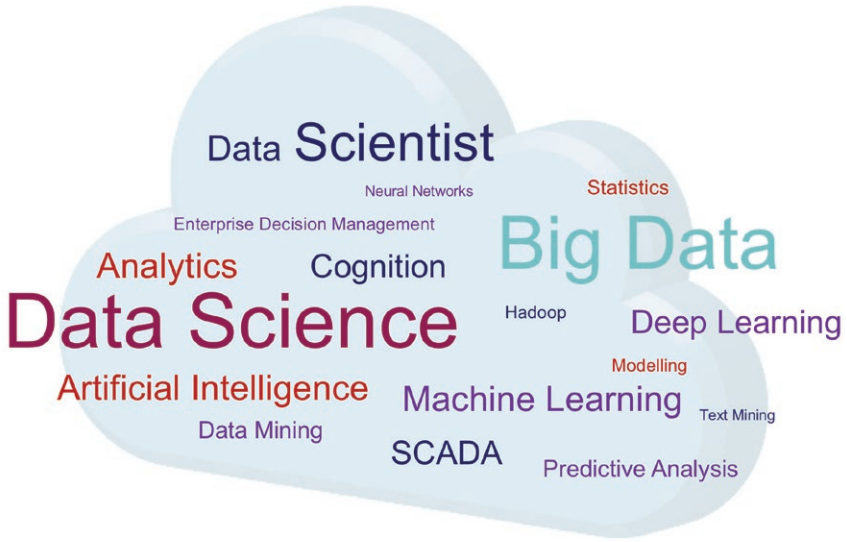
Electronic Devices
A wide portfolio of cutting-edge semiconductor devices for systems and products.

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.

THE FACTORY NEXT DOOR



What is your neighbour doing?
Industry 4.0, Made in China 2025, Smart Factory. Connected Industries. Do all these things seem distant? Think again.

IoT brings both benefits and challenges. It's great that everything is connected and efficiency is improving. But now the world is smaller and your competition is not just in the same town, country, or continent. Like it or not, global competition is on its way.

That's why all those national initiatives are happening – to drive industrial competitiveness. Like it or not, worldwide competition is at your door.

Worldwide competition is at your door.

Made to Order

Today, customers expect 'Personalized' products – being able to select the color, shape, lettering or style of a product. This is Mass Customization. It's a dream for the customer, but a nightmare for the producer. However, if you are not going to provide it, your competitors will. The age of the internet has brought global infinite choice to the table.

Are you ready for Mass Customization?

We are facing a major turning point in history; the ‘Fourth Industrial Revolution’.

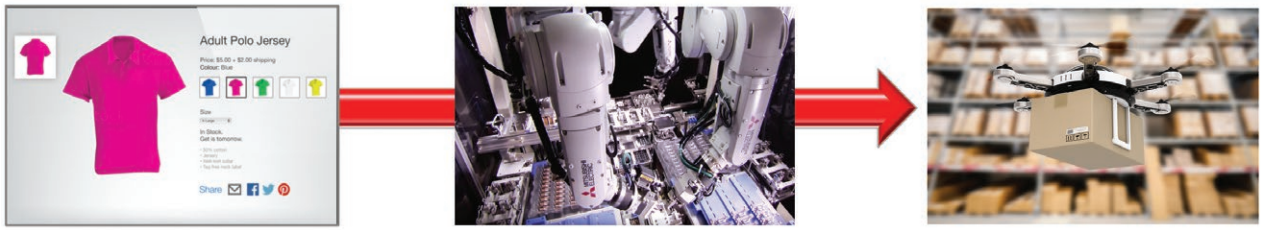
Lean and Flexible

Installing 'IoT' or 'Industry4.0' in your factory is not your goal. Making a cost-efficient, flexible and high quality production line is. In order to cope with the pain of:

- Changing customer demands
- Mass Customization
- Global competition

Your ultimate goal is to create a lean and highly flexible production line.

Installing 'IoT' is not your goal. A lean and flexible production line is.

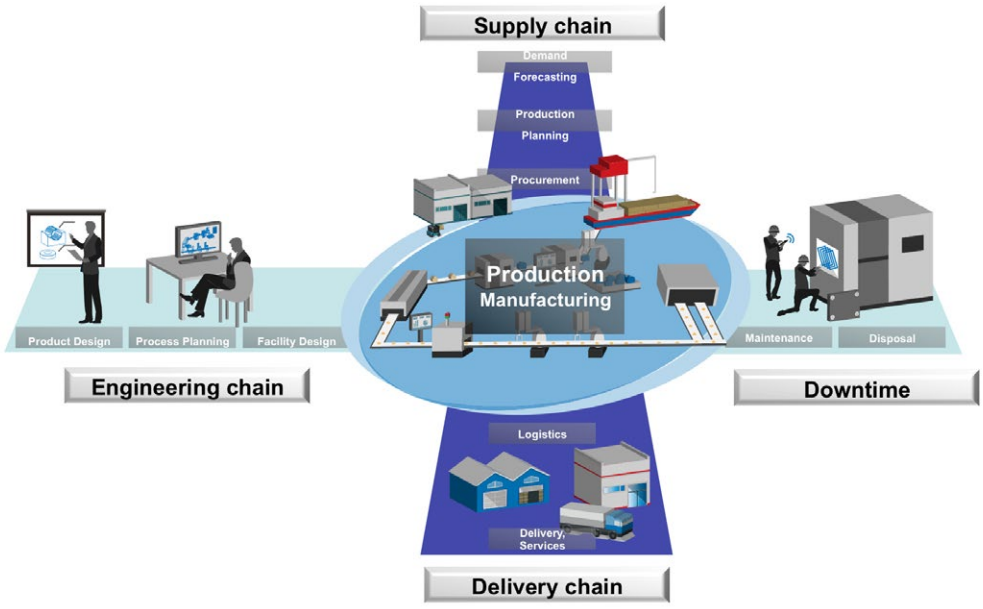


Merging the Chain

Every year, a new model of smart phone is released. As the manufacturer you don't have the luxury of time to develop your production line and keep pace with each release. While you design the phone, you need to simultaneously prepare your production line, merging the Engineering chain with it.

The same applies to the Supply chain. With the rise of e-commerce you are expected to offer next-day delivery. In the past, you only needed to think about connecting within the factory, now you have to connect to various external systems throughout the internet because the customer is already connected to you.

Connecting your factory with the Supply chain and Engineering chains is a must.



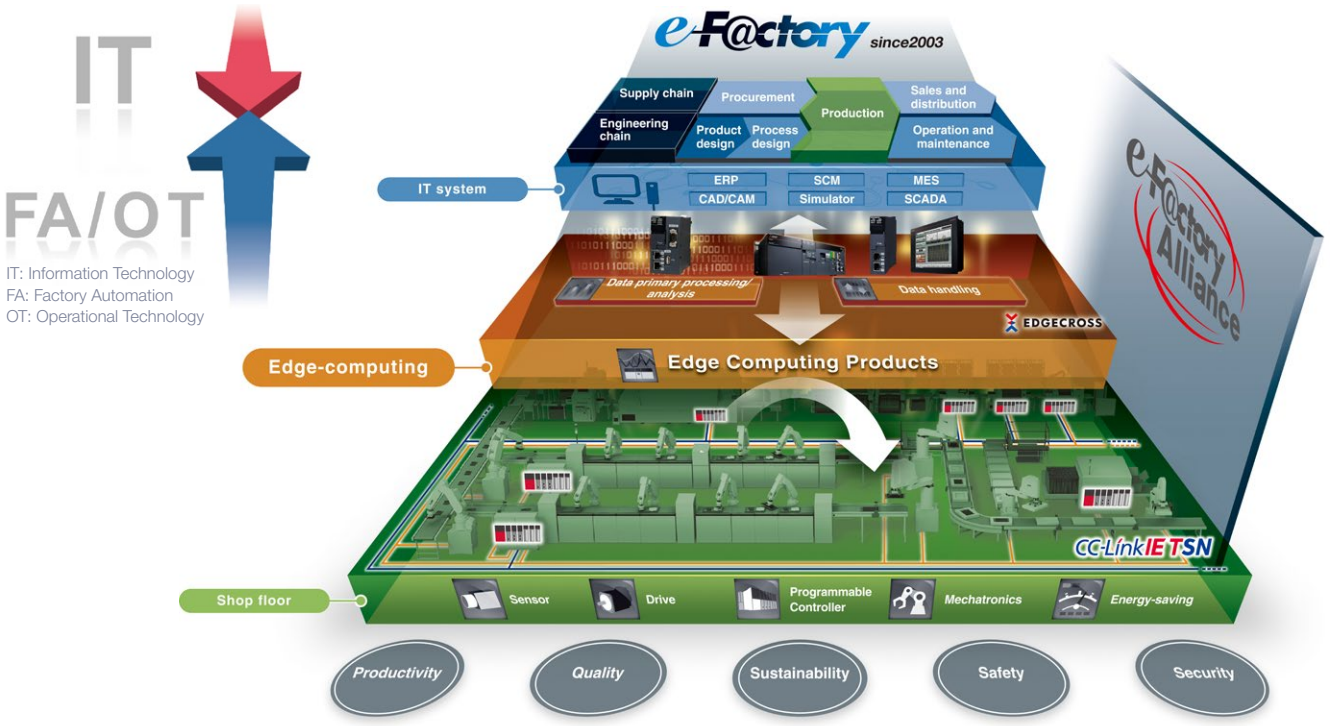
e-F@ctory

Established in 2003.

17 years of experience and lessons learned.

Over 30,000 systems worldwide.

COMBINING TWO WORLDS



The key to digitalization is the integration of IT and FA / OT systems.

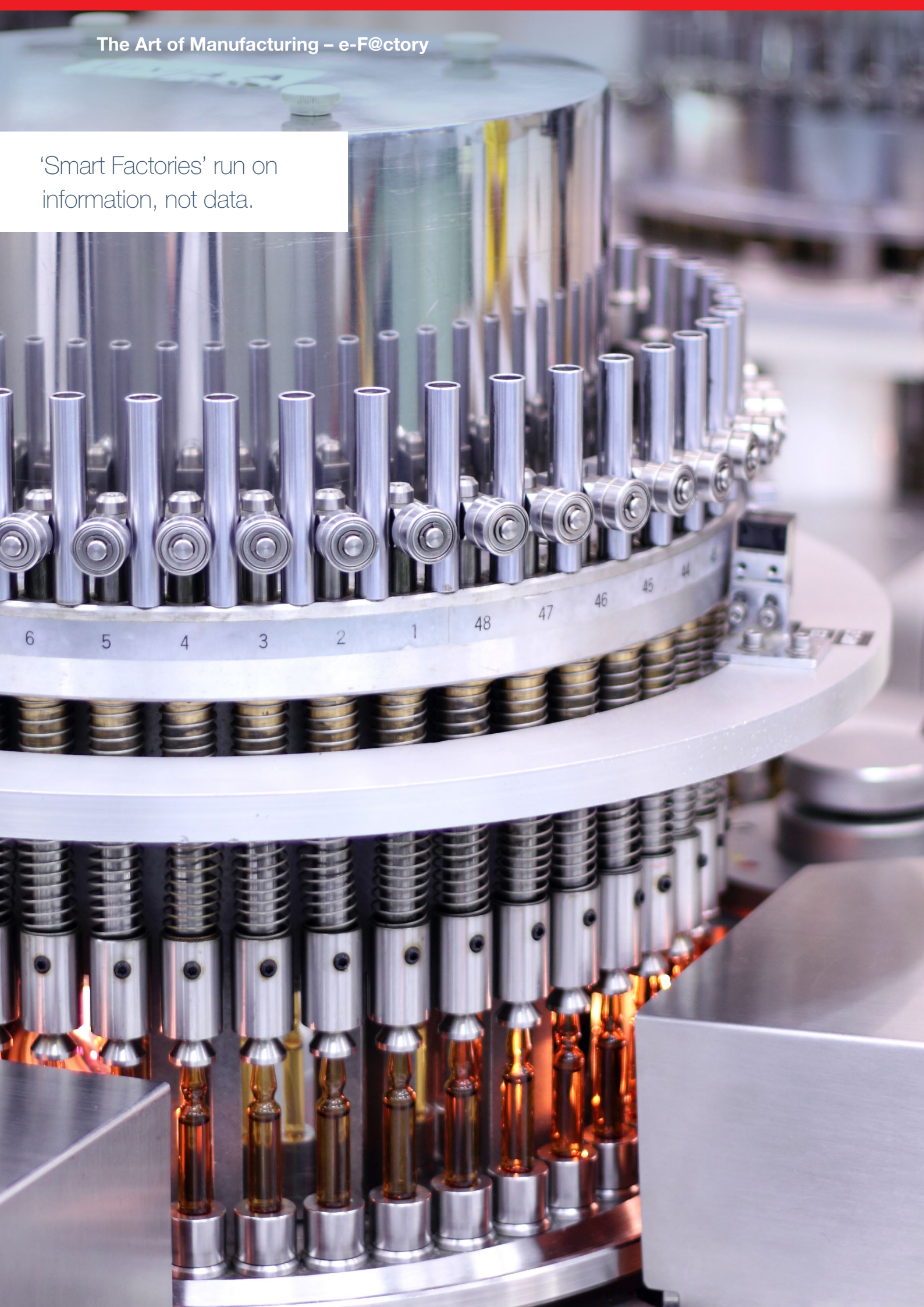
However, IT and OT are totally different worlds. Their two cultures and languages (verbal and programming) are totally different. They don't easily understand one another, so you need a 'translator' layer in between.

e-F@ctory utilizes a refined form of 'Edge Computing' to easily bridge the divide and integrate these two worlds.

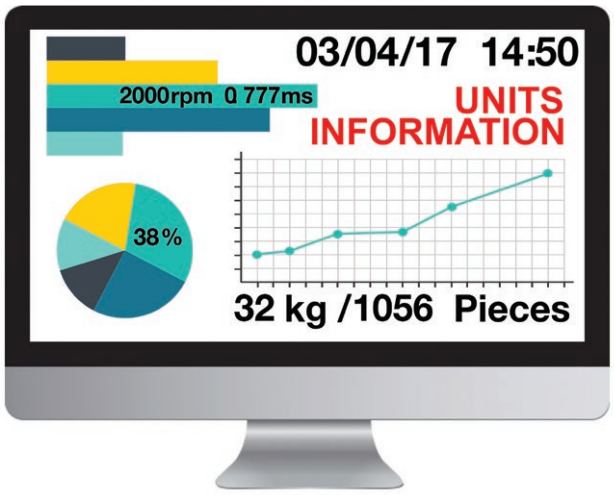
If you want to utilize cutting-edge technology such as AI, Big Data analytics, the cloud and VR /AR in manufacturing it is first necessary to harness the data on the factory floor.

You operate one business. So shouldn't your business operate as one?

‘Smart Factories’ run on information, not data.



TURNING ‘DATA’ INTO ‘INFORMATION’



In order for IT Systems, AI and Cloud computing to solve problems, you first need to add meaning to the data you gather. Without proper meta data and time stamps, for example, computers would struggle to find solutions and patterns hidden in big raw data. It is therefore essential to turn your data into information that your IT Systems can understand.

Collect, organize and then analyze the data.

Are you collecting the right data?

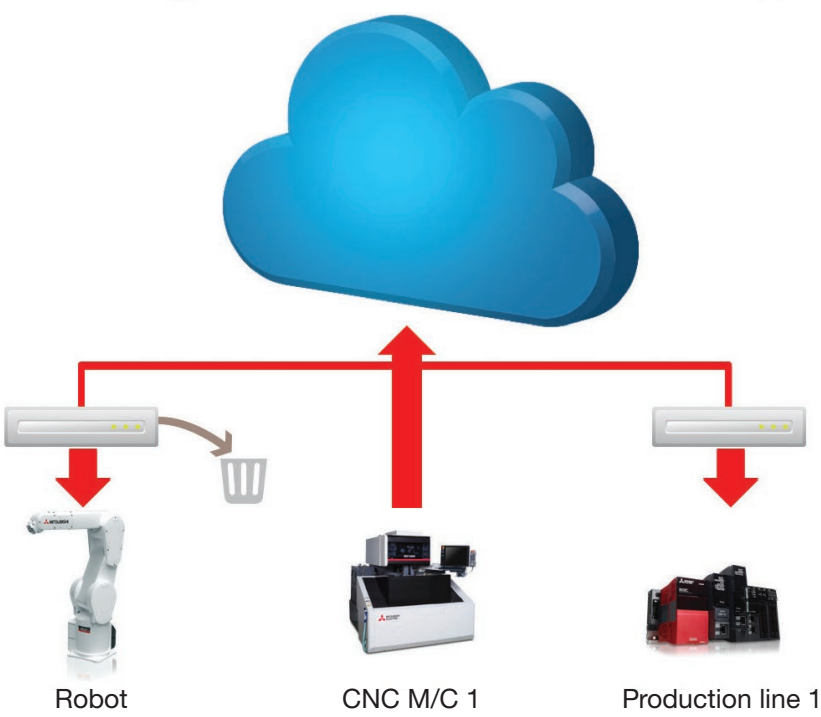
Typically the world of IT ‘Big Data’ operates in minutes, days and weeks. Manufacturing processes on the other hand, work in milliseconds and nano-seconds. This means you need to acquire data at totally different rates than typical IT systems are used to. With so much data being collected, the network infrastructure is often overlooked. Without sufficient bandwidth, time crucial data can frequently be lost during collection.

Missing key events and data can easily lead to false conclusions.

EDGE COMPUTING

Is sending all your data to the cloud the best solution? Today data has a cost, both in storage, transmission, and processing. Sorting the data you use is a must. At the same time operational security is vital. e-F@ctory utilizes Edge computing as a layer between the factory floor and IT systems, to gain additional benefits such as:

- Filtering
- Changing data into information
- Timely reaction
- System resilience



Maximize your operational capabilities by processing on the Edge.

Edge Vs Cloud

Cloud computing

- Developing knowledge

Edge computing

- Knowledge in action

Develop in the Cloud, execute at the Edge.

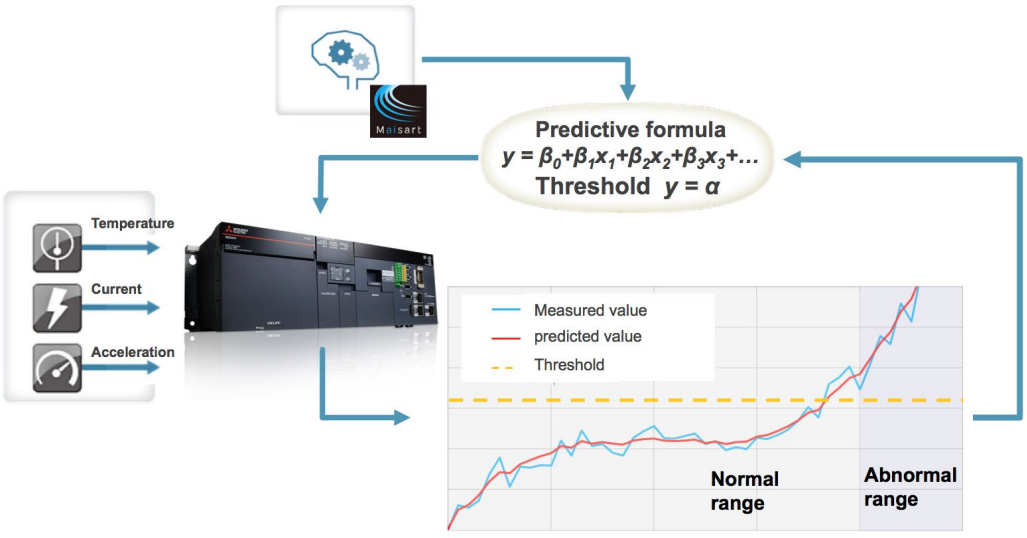
The Edge and Cloud both have their pros and cons. Cloud environments are more suitable for analyzing big data and finding patterns. On the other hand, you need the Edge in order to ensure quick real time response.

SEEING THE UNSEEN

Can you predict when the red gear in the middle will break? It is impossible to physically put a sensor on the gear to monitor its wear and predict possible failure. But, by collecting and analyzing data from around the gear (ambient temperature, motor current, etc.), you might be able to figure out when the red gear is wearing down.

Data Analytics can help you to figure out failures impossible to monitor with sensors.

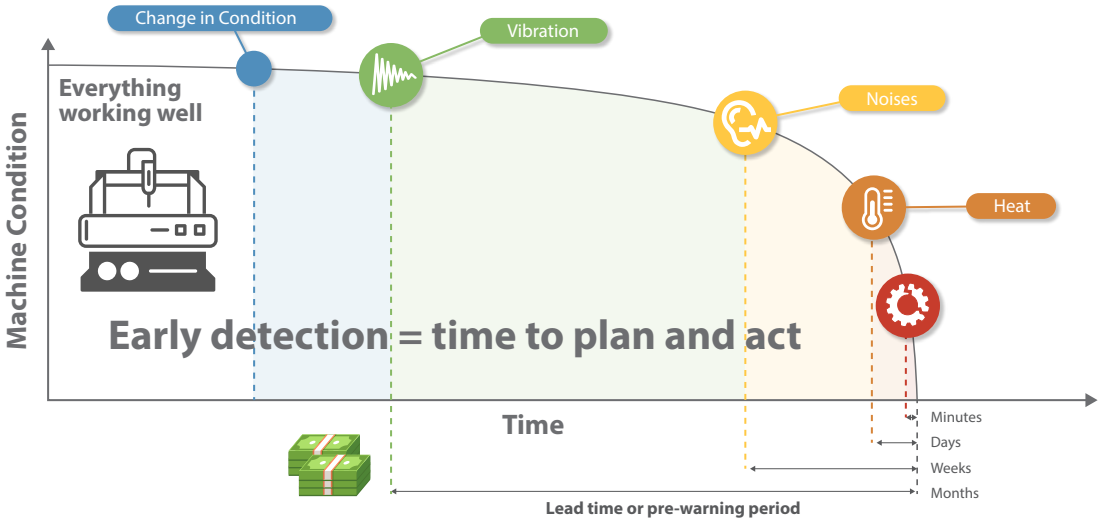
Data Analytics on the Edge



Can you collect data and analyze it at a 5ms interval or less? Often this is the requirement for data analytics in the manufacturing world. Big data analytics is best done in a cloud environment, but monitoring should be done on the edge. It is vital to stop processes the millisecond you find something is going wrong.

Can your autonomous system make split-second decisions?

WHEN IT ALL GOES WRONG



Find the problem before everything goes south.

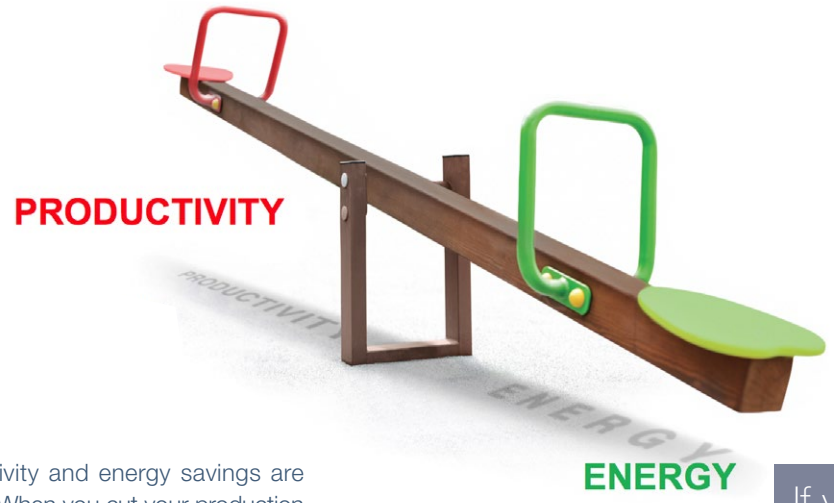
Before your machine stopped and you saw the smoke, there were little warning signs months before. If you could have sensed the extra heat, noise and vibration beforehand, you could have prevented the disaster.

Conditioning Monitoring Systems Your 24-Hour Doctor

Condition Monitoring Systems (CMS) is like a 24/7 doctor check but without the visit. CMS' detect signs of machine failure as soon as they appear, not missing a heartbeat.

24/7 machine health monitoring to prevent unnecessary downtime.

WHAT GOES UP AND DOWN AT THE SAME TIME?



Productivity and energy savings are mirrors. When you cut your production time in half, you are also saving a lot of energy necessary to run your manufacturing operations.

If you improve productivity, your energy costs will go down as well.

Energy Per Unit produced

At Fukuyama Works, a prize-winning energy saving e-F@ctory, the focus is not just energy saving but also vast efforts improving production. One KPI that is essential is EPU (Energy Per Unit produced).

By monitoring this KPI, you can manage the actual energy used for a single unit of production.

Do you know how much energy you use to produce one product?

$$EPU = \frac{\text{Energy consumption (kWh)}}{\text{Production (Units)}}$$

Robots and Artificial Intelligence will be used extensively in factories in the future.

ROBOTS VS HUMANS

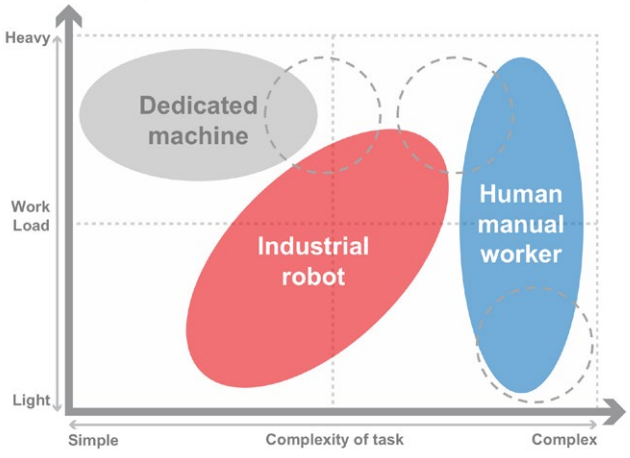
The installation of robots can be your first step towards 'IoT'.

ROBOTS OFFER:

- Easy Mass Customization (Product Change)
- Repeatable quality
- Smaller footprints

Regardless of the environment (or working time), robots will automatically accumulate operational data, making visualization of your production line much easier.

But robots are not suitable for every task. Look at the cost balance, sometimes humans are more flexible, efficient and cost effective.



Source: "Industrial robotics installation guideline" © Ministry of economy, trade and industry, Chubu bureau of economy, trade and industry, Nagoya institute of technology, industry-university-government collaboration

The ideal production line will be a creative mix of robots and humans.

AI: Make Everything Smart

AI is ready to be applied to manufacturing. Adjusting parameters, voice recognition, preventative maintenance and alarming are just some of the tasks that AI will bring to life.

Mitsubishi Electric's MAISART drastically reduces time for deep/machine learning. This not only cuts the system learning time by reducing the number of calculations needed, this also makes it possible to embed your AI capabilities into devices working on the Edge.

From hours to minutes, AI reduces robot learning times.

Robots and automation are key for lean & flexible production.

THE PERFECT AI

Think of a robotic vacuum cleaner. At a press of a button, it efficiently cleans your house, you don't even think about using AI. Our goal is to seamlesslly bring AI into our products and solutions, so that factory staff do not need to be the experts in AI, data analytics, etc. The goal is to make the technology ready to use.

The ideal AI is invisible, you don't even know that it is there.

AI in Robotics

Everybody is looking to install robots for flexible automation, but in reality, programming robots is not an easy job and needs expertise. In addition, robots need to move fast and precisely, "Time is Money", and ROI needs to be ensured. Utilizing AI for easy installation, programming and maintenance will be a key point for the future.

Do you have someone to program all those robots?

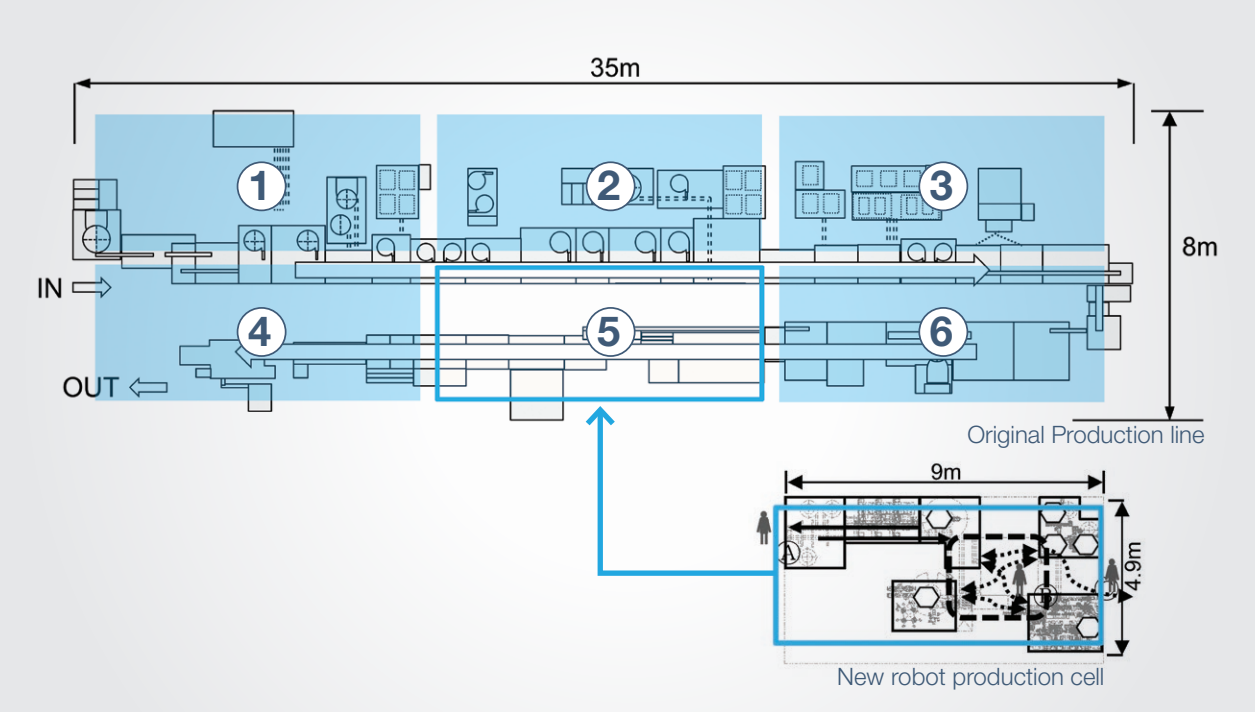
14,000 different
product variations.

Batch size 1.

e-F@ctory IN ACTION

Magnetic Contactors Manufacturing

The Kani campus of Mitsubishi Electric's Nagoya Works, producing motor starters and magnetic contactors, was facing some significant challenges. Chief among these was the sheer number of product variations and possible configurations in their product range – 14,000 in fact. Utilizing e-F@ctory principles, it was possible to transform production, making it more flexible and efficient with a significantly smaller footprint, despite the wide range of products being manufactured.



RESULTS

- Lean and flexible manufacturing, utilizing robots, automation and Edge computing.
- Mass customization by introducing robots and 2D bar codes to the assembly cell lines.
- Improved quality by changing from results management to process management.
- Smaller manufacturing footprint by changing to cell based production.
- Re-engineering people back into the production line.

Greater visibility of the production process is the start point of all improvements.

Printed Circuit Board Manufacturing Line

Challenge: Identifying reasons for line stoppages, production losses due to misplacement of parts and better utilization of collected data.

e-F@ctory Solution

- Immediate feedback on issues relating to suction nozzles and predictive maintenance.
- Gathering production loss and equipment data for feedback to design and operations departments.
- Utilization of Edge Computing system.
- Managing and utilizing data throughout.
- **Productivity UP 30%.**
- **Quality loss DOWN 50%.**

Electronics Factory Product Quality

Challenge: Recovery of product quality levels when reduced numbers of experienced staff lead to mistakes by newer, less knowledgeable workers.

e-F@ctory Solution

- Introduction of Guided Operator Solution (Pokayoke) reducing mistakes by workers.
- Provision of work data analytics for feedback to engineering and faster education of new staff.
- Managing and utilizing data throughout.
- **Quality issues resolved.**
- **Lead-time DOWN 30%.**
- **New employee education time DOWN 60%.**

Waste Water Treatment plant

Challenge: Preventing periodic breakdowns at unmanned remote pumping station.

e-F@ctory Solution

- Installation of remote monitoring solution.
- Gathering data to enable prediction of equipment failure.
- Automatic alert sent to control centre.
- **Increased Overall Equipment Effectiveness (OEE).**
- **Continuous operation through predictive maintenance.**
- **Reduced maintenance costs.**

From big to small. From electronics to process. e-F@ctory solutions are in action throughout the world.

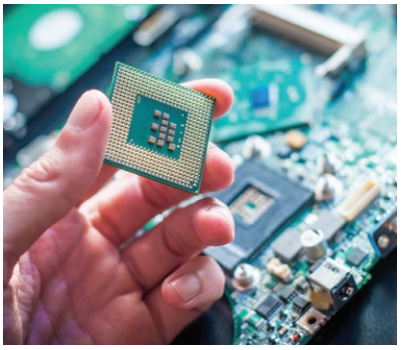
Circuit Breaker Production Line

Challenge: Rising costs due to energy charges, strict government regulation.

e-F@ctory Solution

- Utilizing EPU (Energy Per Unit produced) as a KPI.
- Installation of high energy efficient components and energy management systems.
- FA-IT connectivity solutions to monitor production and energy in real-time.

Quality Production of Electro Plating



Challenge: To predict end quality results without having to run pre-tests.

e-F@ctory Solution

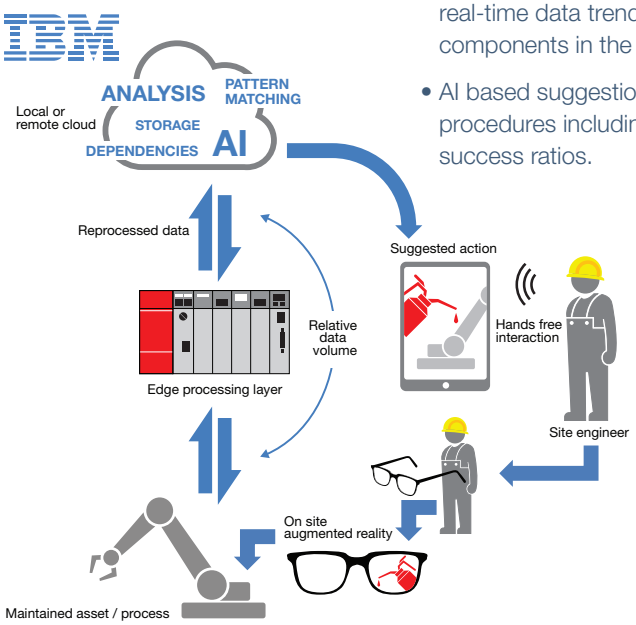
- Real time data acquisition on the Edge using industrial PCs.
- On-site production engineers solve problems without data specialists by utilizing easy-to-use data analytics software.
- No additional sensors or other modifications are necessary to the machine, no interference with the process.

AI / AR / Edge Maintenance for Robotics

Challenge: Realizing a predictive maintenance solution for robotics with automated repair suggestions, scheduling, and AR for manual-less repair procedures.

e-F@ctory Solution

- Edge computing to capture real-time data trends of critical components in the robot.
- AI based suggestions for repair procedures including time and success ratios.
- Automated scheduling of maintenance to avoid disruption of production.
- AR based maintenance making repair procedures possible without physical manual documents.



Confectionary Production Line

Challenge: Enable total quality and production management of a multiple food processes with minimal staff.

e-F@ctory Solution

- Easy data collection and processing with Edge Computing facilitated by Edgecross.
- Data visualization of sensor data like temperature, vibration, pressure.
- Real-time data analytics to halt production at times of potential quality issues.
- Total operation management of the production line via SCADA systems.
- Low-cost preventive maintenance through solution kits for individual equipment and machinery.

Welding Material Manufacturer

Challenge: Paper based operation, and reliance on individual actions. Maintenance of skilled workforce and prevention of knowledge loss.

e-F@ctory Solution

- Central management system in one Database; collecting data from the factory and merging with sales management system.
- Automation of inspection processes using industrial PCs to perform data analytics from sensor data.
- Installation of industrial robots for parts transfer between machines.
- Utilization of preventive maintenance solution kits for individual machines.
- **In-process and final product stock 8% down**
- **Transportation cost 5% down**

Fan and Motor Quality Traceability

Challenge: Realizing quality measurement of processed parts, equipment alerts, and traceability utilizing 2D barcodes.

e-F@ctory Solution

- Utilizing Edge Computing to communicate and process alerts from the equipment to the wearables of the maintenance staff.
- Off-the shelf S/W for monitoring and alarm setting for cost reduction and for easy usage by onsite staff.
- Precise data quality acquisition of quality data of high precision parts production through edge computing.

EDGECROSS

It has always been a challenge to collect and share data efficiently in manufacturing. Bespoke standards, lack of common approaches and terminology are all challenges to overcome. So with digitization in factories, the first task you face is to connect data with systems. This has led to the development of the Edgecross Platform by the Edgecross Consortium – a multi-vendor partnership dedicated to providing solutions that deliver 'the Right Data to the Right System'.

THE KEY TO UNLOCKING THE FACTORY FLOOR

Edgecross provides the key to connecting:

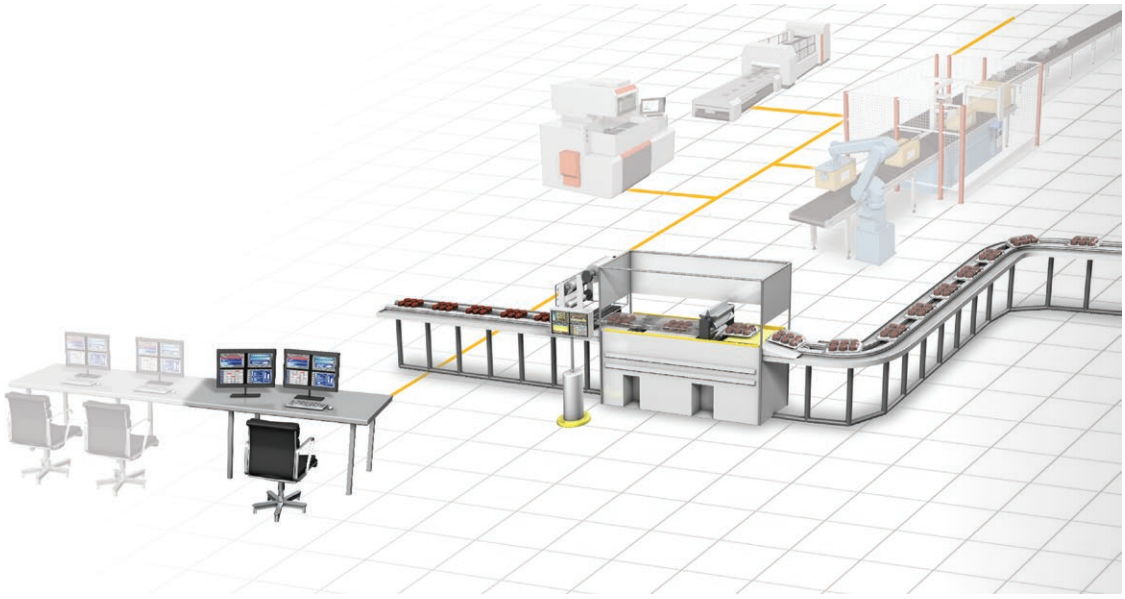
- Multiple vendor devices and networks.
- Legacy systems.
- Diverse IT software.
- Different data storage systems and formats.
- Various cloud environments.

EDGECROSS

The open edge computing software platform has a strong focus on edge computing for manufacturing and offers:

- Seamless coordination between FA/IT systems.
- Real time diagnosis and feedback.
- Operates on Industrial PC.

Dream Big, Start Small

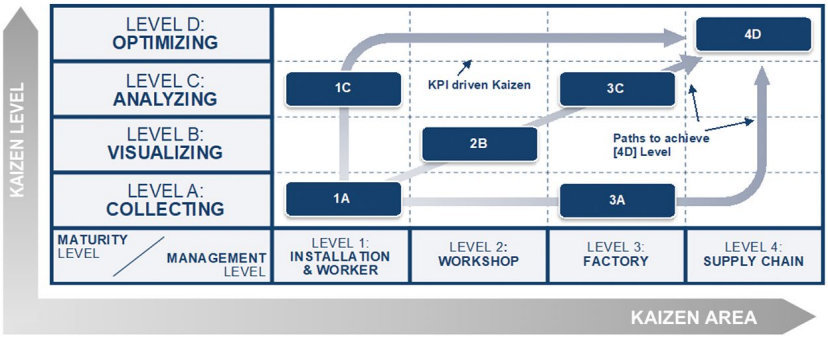


At the end it is ROI.

Dreaming big is important, you need to have in your mind your ideal factory, it will only become what you dreamed. But at the end, a factory is a sum of the individual machines and production lines. You need to assure and prove to your management you can achieve the ROI on a machine level to get approval for the next steps. At the end, you can use the greatest and latest technology, but if you can't reduce your cost of manufacturing, what's the meaning of doing it?

Smart Manufacturing Kaizen Level

Industry IoT is a journey. Like a journey, you first need to agree where to go, how much time it will take, and what are the necessary resources.

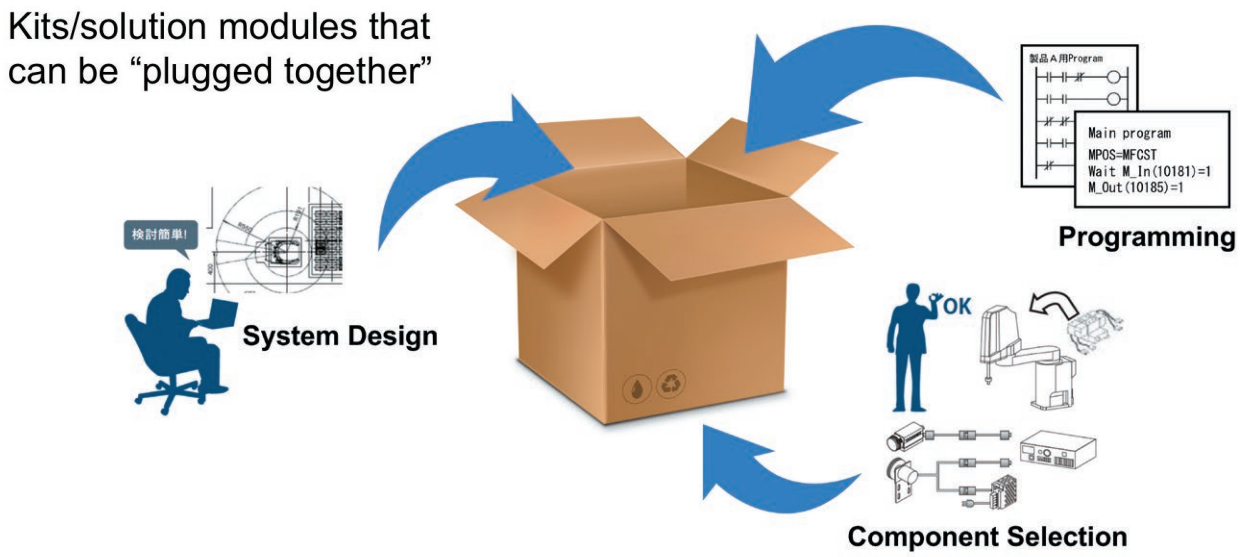


Do you have a Map and KPIs that everyone agrees on?

Investments in IoT are exactly the same. Being on the same page, defining the scope, and reviewing at each stage is a must. IoT is achieved in steps, not leaps. Smart Manufacturing Kaizen Level (SMKL) is a planning matrix that helps to execute smart manufacturing solutions.

Learn more in this White Paper from the ARC Advisory Group.

Easy e-F@ctory



Many companies lack the resources and personnel to install and utilize IoT solutions. Hybrid IT/FA engineers are a rarity. Utilizing packaged solutions will allow you to adopt the latest technology with limited investment and expertise.

Utilize ‘Plug and Play’ technology. No need to develop everything by yourself.

5G in Manufacturing

There are technology and political hurdles that 5G needs to clear, so you won’t see a full 5G factory in 2021, but the future is coming.

No wiring, and the flexibility that comes with 5G has always been a factory manager’s dream. In addition, 5G will immediately help you with high resolution imagery, for easier remote maintenance, seeing what you couldn’t see before. Start getting ready, the future is on your door steps.

Wireless, Manufacturing AI in the cloud, endless possibilities.

A PARTNERSHIP FOR SUCCESS

BEST IN CLASS

Mitsubishi Electric always strives to deliver open solutions. The e-F@ctory Alliance provides an open environment in which customers can select the best partner for their needs. In this increasingly competitive world, manufacturers want to gain as much advantage as possible. Utilizing 'best in class' suppliers is a must and being able to draw on an ecosystem of strong complimentary suppliers is a big plus.

That's the e-F@ctory Alliance benefit.

e-F@ctory Alliance

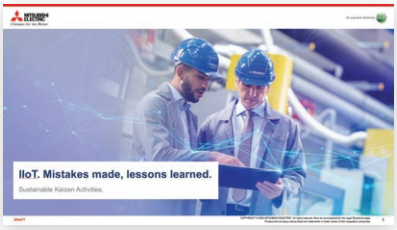
An alliance of technology experts to help you meet today's and tomorrow's manufacturing challenges – together.

Need a hand to unravel the mysteries of Digital Manufacturing?

WE HAVE MORE DETAIL ON

- Installation stories
- Solutions
- Catalogs
- e-learning
- e-F@ctory alliance partner
- Thought leadership on YouTube
- Webinars

Please contact your nearest sales office



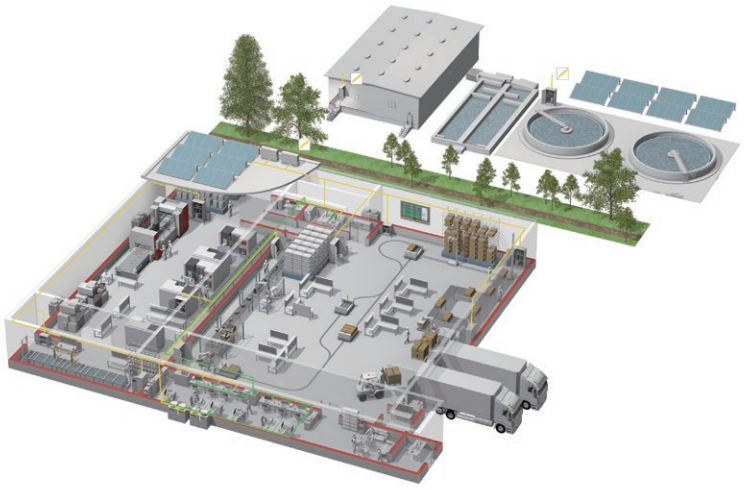
Smart Manufacturing Kaizen Level

Latest Industry IoT trends for everybody

AI applied to Robots

ARC White paper

YOUR SOLUTION PARTNER



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

Low voltage: MCCB, MCB, ACB

Medium voltage: VCB, VCC

Power monitoring, energy management

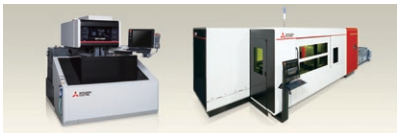
Compact and Modular Controllers

Inverters, Servos and Motors

Visualisation: HMIs

Numerical Control (NC)

Industrial / Collaborative Robots



Processing machines: EDM, Lasers, IDS

Transformers, Air conditioning, Photovoltaic systems

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.

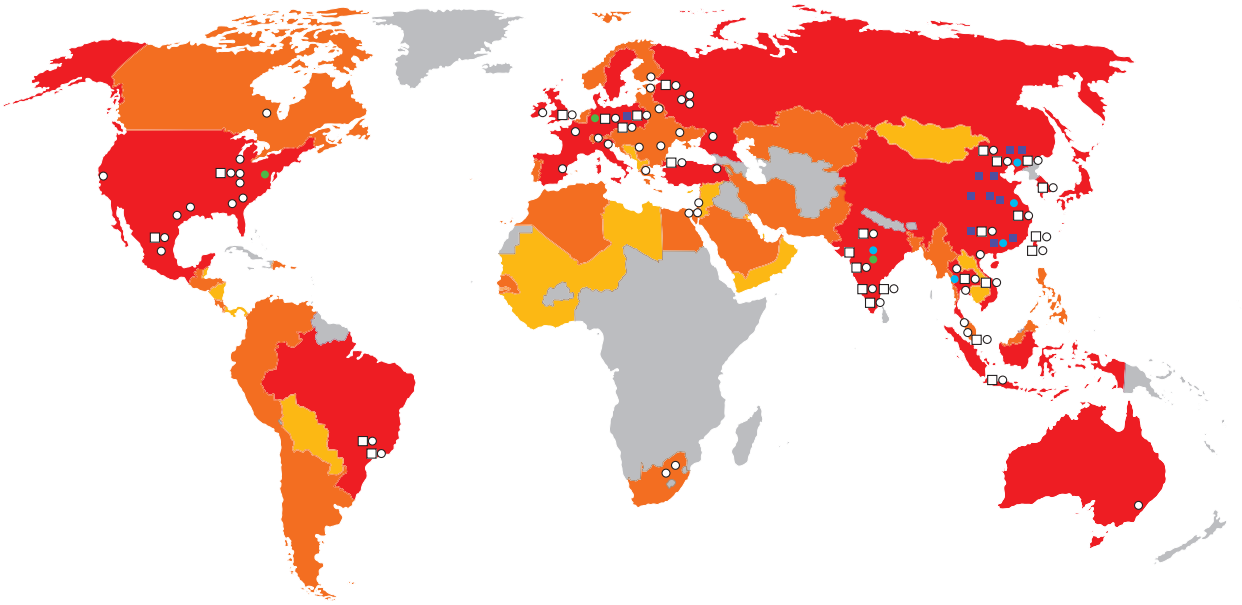
Mitsubishi Electric Corporation, established in 1921, is active in space development, transportation, semi-conductors, energy systems, communications and information processing, audio visual equipment and home electronics, building and energy management and automation systems, and has 183 factories and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

This is why you can rely on Mitsubishi Electric automation solutions – 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.

* Not all products are available in all countries

Global Partner. Local Friend.



○ Sales office
□ FA center
■ FA center satellite
● Production center
● R&D center

Note: This is a map of our global sales and support coverage. It does not reflect any national boarders.
■ A region where there are direct Mitsubishi Electric FA offices (main/local and satellite).
■ A region covered by primary sales partners (distributors) who have local sales offices.
■ A region covered by our extended sales network which may or may not have local offices.

Country/ Region	Sales office	Tel/ Fax
USA	MITSUBISHI ELECTRIC AUTOMATION, INC. 500 Corporate Woods Parkway, Vernon Hills, IL 60061, U.S.A.	Tel : +1-847-478-2100 Fax : +1-847-478-2253
Mexico	MITSUBISHI ELECTRIC AUTOMATION, INC. Mexico Branch Mariano Escobedo #69, Col. Zona Industrial, Tlalnepantla Edo, C.P.54030, Mexico	Tel : +52-55-3067-7500
Brazil	MITSUBISHI ELECTRIC DO BRASIL COMÉRCIO E SERVIÇOS LTDA. Rua Jussara, 1750- Bloco B Anexo, Jardim Santa Cecilia, CEP 06465-070, Barueri - SP, Brasil	Tel : +55-11-4689-3000 Fax : +55-11-4689-3016
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