

# THE ART OF MANUFACTURING

ものづくり



monozukuri

ISSUE 1

Mitsubishi Electric Factory Automation Customer Magazine



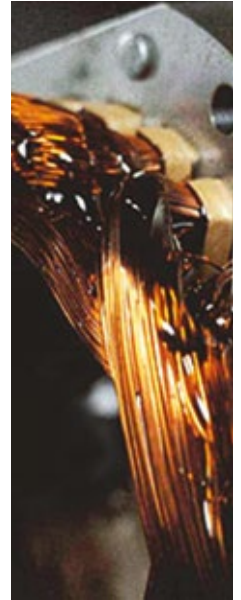
**SUSTAINABLE GOALS**  
Energy saving is  
in our DNA

**THE ENERGY  
EDITION**

**DR ENERGY**  
A surprising way to  
protect your plant

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# Use it. Reduce it or Pay for it.

Welcome to our first edition of the *The Art of Manufacturing – Monozukuri* magazine. In this edition we will focus on one of the necessities of life, especially in manufacturing, which we all take for granted... and by that, I mean energy. I hope my provocative title makes you think about that precious resource because it is something we consume and yet think little about.

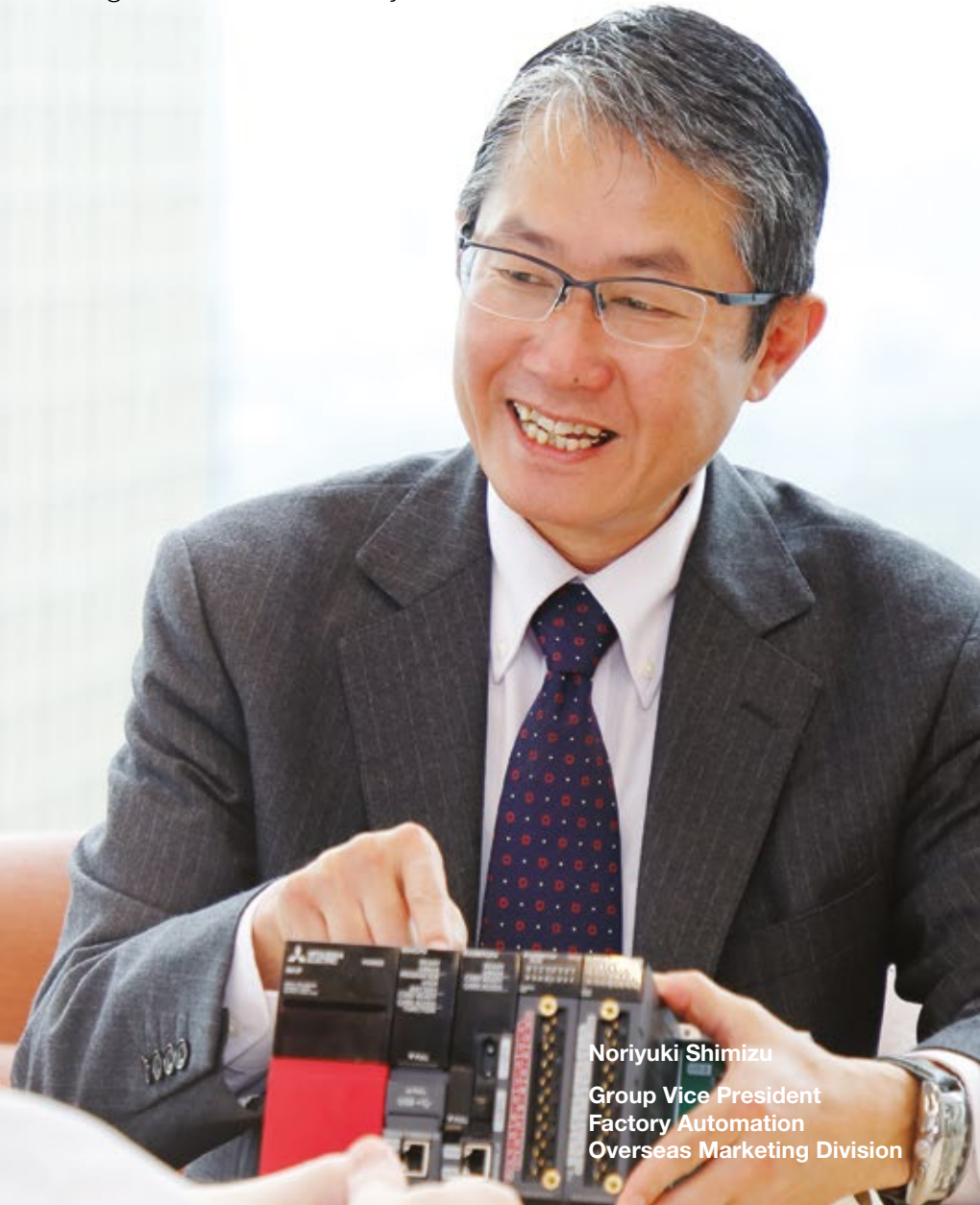
One of the cornerstones of Mitsubishi Electric's ambitions is to be a global, green leading company, enriching society with technology. It is why we have both our eco-changes logo but also why we have consistently executed our environmental plan, now just starting its ninth iteration for the fiscal period 2019-2021.

It goes without saying that we are temporary custodians of the earth and should take all measures to ensure we pass it on to our children and their children's-children, in as good or better condition than we inherited it, but actually there is an awful lot of good business sense in this as well.

Let me give you a couple of things to think about which we will explore in more detail later pages:

- Energy is a cost of manufacturing which can be continuously consumed even when we are producing nothing... does it make sense to generate unnecessary costs for no benefit?
- Energy is like the blood of the manufacturing plant, it carries the power to all parts of the body/plant but can also be used to diagnose unseen problems.
- Have you ever thought how energy could be recycled and reused?

Let's look in to these and other surprising aspects of energy in this edition of *The Art of Manufacturing – Monozukuri!* ■



**Noriyuki Shimizu**  
Group Vice President  
Factory Automation  
Overseas Marketing Division

# Sustainable goals

The United Nations developed their 2030 Sustainable Development Goals to enhance everyone's quality of life; they range from Poverty to Climate action, care of the Environment both on land and below water to education. These things concern us all and make good sense. They make even more sense when they can also help us improve and achieve even better monozukuri, the art of manufacturing.

As you know Mitsubishi Electric originates from Japan, and one of the interesting but relatively unknown points about Japan is it has had to develop a culture of self-sufficiency as it no longer has any natural resources.

- No oil
- No gas
- No coal

In numbers it is only 6% self-sufficient in energy. That means energy has to be imported and that is expensive, so saving energy is embedded in to every aspect of our daily lives.

## Taking care

Mitsubishi Electric is just about to start its ninth environmental plan which will run from 2019-2021 which will coincide with the 100th anniversary of the company. Among its goals is to create and popularize energy saving products, and reduce CO<sub>2</sub> emissions to create a low-carbon society. Today, Japan is a very difficult country to manufacture in and still compete aggressively on the global stage, as nearly all resources are expensive; from energy to labor, so in order to survive we have developed and adapted until energy saving is part of our DNA and that has also been recognized by CDP awards for Climate and Water. So our mission is to share our experience and know-how to achieve this important goal.

## 3 R's of Sustainability

Many people have never heard of this but it is as important as Kaizen. The three R's refer to:



### Reduce

use of unnecessary things



### Reuse

items whenever possible



### Recycle

items when their useful life is over.

And in the case of energy, especially from a corporate or manufacturers standpoint, it's even tougher. If you use it you have two choices:

## Reduce it or Pay for it!

It's totally unavoidable... like paying taxes!

And to make things worse, energy prices have been going up steadily over the past years. In fact the US Energy Information Administration have demonstrated that the average retail price of electricity has increased 53% for home users and 42% for industrial users... so it makes sense to treat energy as a precious resource and in some way use it 'Just In Time'.

So understanding when, where and how much energy is used is the first step to managing its consumption.

*According to the US Energy Information Administration the average retail price of electricity has increased over the past 15 years.*



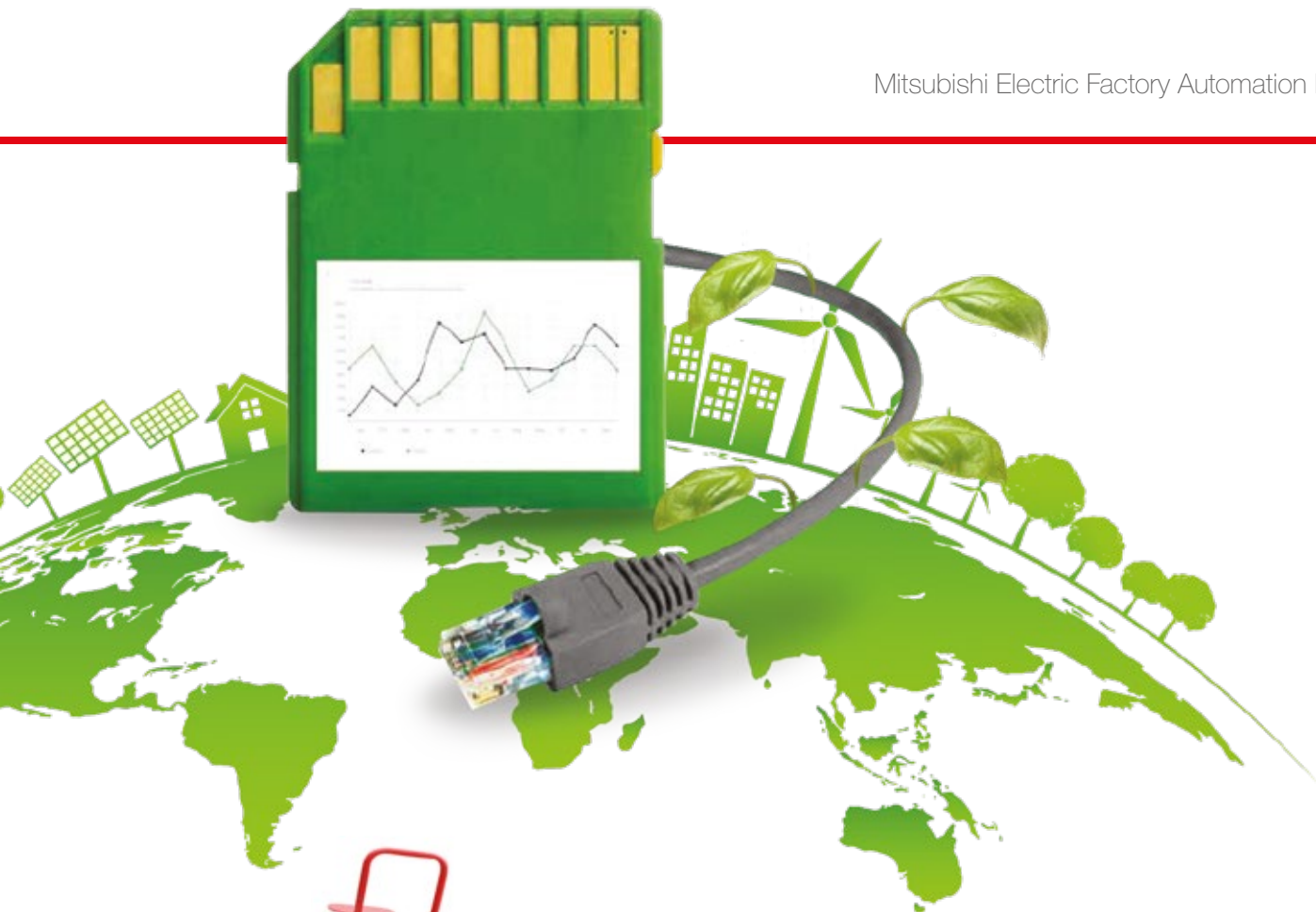
**53%**

Home Electricity



**42%**

Industrial Use



What goes **Up** and down at the same time?



**The challenge**

Ok, it's a small joke, we can see that it's a see-saw, but in a manufacturing context actually this is a bit more serious because it hits the bottom line; the actual answer is Energy and Productivity.

Energy saving could be simply executed by turning all your machines off... but how does that help because you are unable to produce. Therefore, if you focus on improving productivity, i.e. making more saleable products with less energy you have solved the real puzzle.

And that's why Mitsubishi Electric energy saving is not about cutting costs but about improving productivity.

**Key concept**

There is one key concept which is fundamental to changing the perception of energy usage. We call this:

**EPU**

It represents the amount of Energy consumed to produce one product (Energy Per Unit produced).

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

EPU has two powerful attributes; it allows the direct association of the energy cost to the manufacturing activity; it is also variable/dynamic. That does not sound so important until you have a line stoppage and the EPU starts to rapidly increase as energy is consumed but product is no longer being produced.

The second attribute is that it makes it easy to compare production performance between lines, or even factories because the EPU is entirely driven by the efficiency of production, i.e. productivity. And this is why we use it to benchmark ourselves but also to drive our energy saving activities.

Typically manufacturers have a very clear idea of the material costs, direct and indirect labor costs, logistics, depreciation etc related to their manufacturing processes. But very rarely do they actually know anything other than the headline energy consumption.

By applying the e-F@ctory 'concept of connect everything' and measure what's important we are able to derive the EPU. The great thing is energy monitoring can be applied retrospectively to any existing site or machinery. Modules can be added to existing breakers directly or distributed measurement points can be installed without disrupting the existing production or cabling – simply clamp over the appropriate CT modules.

Connecting these to local meters and monitoring stations makes it easy to pull all that data back to a central management point. The more visibility you give to that data the more change effect you can create. In the next few paragraphs we will highlight this in action with some real use cases.

## Environmentally sensitive cabling?

### With Anywire you can.

Did you ever think about how environmentally friendly it would be to reuse existing cabling as new network cables?

Anywire's flexible 'Topology Free' concept enables efficient wiring paths that reduce cabling and time. It features high noise resistance and compatibility with general purpose cabling, even allowing the reuse of existing electrical wiring. You can also take advantage of its innovative diagnostic options to monitor both sensor performance over time and connection status, and pre-empt costly work stoppages. Saving time and money and reducing the impact of your manufacturing infrastructure on the environment.

Anywire is another great example of the e-F@ctory Alliance in action.

For almost 100 years Mitsubishi Electric has chosen to conduct its business under seven guiding principles:

- 1 Trust.** Establish relationships with society, customers, shareholders, employees, and business partners based on strong mutual trust and respect.
- 2 Quality.** Provide the best products and services with unsurpassed quality.
- 3 Technology.** Pioneer new markets by promoting research and development, and fostering technological innovation.
- 4 Citizenship.** As a global player, contribute to the development of communities and society as a whole.
- 5 Ethics and Compliance.** In all endeavors, conduct ourselves in compliance with applicable laws and high ethical standards.
- 6 Environment.** Respect nature, and strive to protect and improve the global environment.
- 7 Growth.** Assure fair earnings to build a foundation for future growth.

Being a leading green company is in our DNA, it helps the environment, is a social duty but it also makes good business sense.

## Case #1: The circuit breaker line

As noted, energy costs have been rising but in Japan this was compounded by the consequences of the Fukushima earthquake which meant all nuclear power plants were also shut down, leading to even more expensive energy and in some areas additional usage regulations.

### Problem:

- Rapidly rising energy costs
- Strict government regulation

### e-F@ctory solution

- Introduction of energy efficient components
- Energy management system
- Production improvement using FA-IT connectivity

Firstly, the energy consumption needed to be visualized, that meant energy data needed to be collected from every part of the process. The result was a very clear picture which could be drilled down from production hall, to line to individual machine. The other key aspect was the time base of the measurement frequency – this is also critical to catch the real root cause of problems. Looking for correlation between events even on different processes and machines quickly reveals where the real problems are.

The last major learning point was that sadly technology does not solve everything. There has to be a strong commitment as a company, which filters down to every employee working towards the same goal and that's why sharing the data on a wide basis makes everyone aware of the scale of the problem.

Then it's a case of going through the simple steps of visualize the issue, find the cause, take action – its pure PDCA!



*For a low margin product like a breaker, coupled with fierce global competition, every cent saved counts.*

## Case #2: The circuit board line

In this example, the direct impact of EPU analysis will be demonstrated.

### Problem:

- Multiple machinery and production lines
- Frequent line stoppages made it hard to grasp the real energy usage

### e-F@ctory solution

- Energy data visualized per machine
- EPU KPI applied

As in Case #1 the first step was to collect the data, but collection was not limited to energy only. Additional information such as the production schedule, equipment data, quality data and process error data were also collected. The critical point was this was collected in 'real time'. That meant extensive line side data processing, time date stamping and filtering, so Edge Computing was an important element to make that possible.

Initially we were flooded with data, graphs and analysis – we could not see what was happening so we applied EPU. Then we could pinpoint when production dropped and energy peaked and cross reference that with error and quality information.

### We noticed several things;

- We were setting up/starting the machines too early in the morning before main production commenced.
- We saw frequent stops due to material shortages.
- Equipment trouble and extended downtime occurred because maintenance members all took their break at the same time.



*Sometimes the problem is a combination of events or things that happen infrequently, so capturing and analyzing the data are important steps to get right.*

We also saw our biggest energy consumer was naturally the curing oven, but we could not continuously turn it on and off as there needed to be a constant temperature and there was a lag in taking action and its effect. So from the EPU analysis we had identified that the utilization of the oven was the single most important issue; we needed to keep it as busy as possible.

### What to do?

To minimize non-productive time when we changed production between product lines (when we are consuming energy but producing nothing) we implemented a 'Change Over' support system to reduce the downtime and number of changes needed – so it was fundamentally linked with the production planning system. The result was worth it, we reduced energy by 30%.



*Small incremental improvements are better than no improvements at all. Every solution does not have to be 100% correct but will move you closer to the goal.*

## Case #3: Energy predictive maintenance

The title of this example is quite a heavy hint to what we did. When a machine fails it is no longer productive but may still be consuming resources, so understanding in advance when a machine is likely to fail can be a big help – and energy consumption can be a great indicator of when something is going wrong. A simple example is when a motor bearing is running dry or is damaged it encounters more friction and hence consumes more energy.

So now the energy consumed can be an indicator of the health of the motor.

In this case it really was a motor which was failing a vacuum pump which was part of an electronics production line.

### Problem:

- Sudden breakdown of vacuum pump (even though it had an expected life of 3-5 years)

### e-F@ctory solution

- Improved OEE; monitoring the motors power consumption for predictive maintenance
- Simple solution without any additional sensors – just using the existing data

## Case #4: Small changes, big results (Fukuyama Works)

In the last example we can see elements of the three previous examples deployed alongside the efforts to change 'human' behavior. Over 10,000 visitors per year come to Fukuyama Works to hear how we managed to save around 1,700kW off of peak contract demand – that's equivalent of a small solar station covering 3.4 hectares or 100m JPY; for simplicity let's call that 1m USD per year...every year. The all-important EPU reduced from 14.3 JPY/unit to just 5.5JPY/unit... that's 62% down.

The video below gives you a bit more insight in to this amazing story:



*It's important to start on small projects where you can check you are getting the ROI you expect, then work up to bigger projects 'experience is the best teacher'.*

And remember, a lot of the activities were simply to remind people to turn lights off, adjusting the air conditioning temperature by 1 or 2 degrees, checking for worn motors, identifying root causes.

### The way forward

Not everyone is an energy expert so we have packaged up a lot of know-how in to smart components, ready to use templates and solution packs.

We are also happy to receive fact finding visits to the factories to see what has been achieved. ■

## News from around the world

### INDIA

#### Imaginative eco-solution from winner of the ME Cup India

##### Education program winners

The winners of the Indian ME CUP 2018 (Engineering competition for students) started their education and fact finding trip to Japan with a visit to Mitsubishi Electric's headquarters. There they received an award recognizing their outstanding achievement from Eiichi Harada, General Manager of the FA Overseas Planning & Administration Department.

During the visit the winning team from the Dayalbagh Education Institute in Agra explained about their solution for a Multipurpose Mobile Powerhouse. Following this they moved on to various Mitsubishi Electric Works and factories to study and learn more about the latest e-F@ctory smart manufacturing initiatives.



Five members of the Dayalbagh team (left hand side) and their mentor, Professor Bhagwan Das (center) welcomed by Eiichi Harada, Yoshihiro Fujita and Shrikant Takale.

### RUSSIA

#### Understanding e-F@ctory

##### Corporate media tour

Both our Nagoya and Fukuyama Works are the recipients of frequent visitors from overseas. Often these are customers, but also there is a steady stream of media representatives as well. Typically the media visitors are industry specialists but every now and then our corporate team are hosts to editors and journalists from economic or mass media who are on fact finding missions to learn more about Mitsubishi Electric.

The party below are no exception these influential writers were visiting us from Russia where there is a great interest in digital manufacturing and the global economy.



### JAPAN

#### Discovering e-F@ctory

##### TV media report

At a recent exhibition in Japan the satellite TV company The Discovery Channel made a short interview/report with members of our e-F@ctory team. As you may know The Discovery Channel is famous for its factual reporting of historical, technological and innovation issues, so the topic of e-F@ctory was a perfect match!

Even though the report is mainly in Japanese with some short English side comments/captions we, recommend you take just a couple of minutes to watch this!



The Discovery Channel came to discover e-F@ctory at a recent exhibition in Japan.





CHINA

CeMAT Asia

Vertical industry Exhibition

Anybody connected with the materials handling industry will immediately know the name 'CeMAT'. This global series of exhibitions brings together all aspects imaginable around that industry. Attending for the first time, FA Overseas Marketing Division and MEACH our local sales company, created a booth of wide appeal.

Solutions was the keyword and so products from regenerative inverters to line side edge computing were shown in application examples. Additionally, customer reports, including a video report on warehouse management for a global ecommerce company attracted visitors. We can certainly expect to be attending more vertical industry exhibition activities in the future.



USA

Seeking knowledge

Visit by young roboteers

Robots have a timeless appeal for all members of society, from the very young to the adults. What makes it even more appealing is if you are involved in your very own robot competition. A party of students from Moanalua Middle School, Hawaii were in Japan for an international robot competition, but while they were here they asked if they could visit Mitsubishi Electric to see some industrial robots in action! We quickly agreed and invited them to our new Automation Solution Center in Akihabara, Tokyo, where a variety of applications and robot types can be seen performing tasks such as assembly of box lunches to wheel management in an automotive setting. Hopefully we have inspired a new generation of engineers; we look forward to meeting them again in the future.

GLOBAL PARTNER. LOCAL FRIEND.

Our Stories.

Customer voice

Have you seen our promotion of your successes? Over the past few months we have been developing our "Global Partner. Local Friend." message by sharing customer case studies from around the world – especially those stories where customers have a strong opinion about the value and support they have received from their interaction with Mitsubishi Electric and our local representatives.

If you have not seen these already, please visit [mitsubishielectric.com/fa/cssty](http://mitsubishielectric.com/fa/cssty)



Celebrating your successes all over the world – **if you have a story you want to share please contact us!**

# DrEnergy



Who would have thought that the management of energy could lead to more efficient maintenance processes and the increase of plant safety? That was exactly the result of this e-F@ctory application created by Nitto Denko Corporation at their Kameyama Plant 2.

Having developed specialist knowledge in technologies such as adhesives and coatings, Nitto continues to apply this understanding and provide unique products to diverse business areas like; electronics, automobiles, and residential building materials. Among other things, their Kameyama Plant is responsible for the production of CISFLEX®, a thin-film metal-based board used for precision circuits in hard disk drives as well as transparent resin for LED sealing and polarizing film for liquid crystal displays.

Operation began at the Kameyama Plant in 1969. Plant 2 has been in operation ever since, with products including the varnish which protects coils in ecological car motors and moisture-proof coatings for electronic substrates. Both use flammable liquids in their manufacture necessitating the establishment of strict fire control standards; even so, concerns arose about leaks from old wiring and electrical machines used at Plant 2.

“Plant 2 has no shortage of devices and wiring that have been in use for over 40 years, since it began operation. But it’s not realistic to replace them all for new. We had to handle the problem by raising the everyday monitoring level.” said Mr. Shinya Ueki, Senior Technician at the Production Technology Section of Nitto ICT Sector Manufacturing Supervision Department.

As a general rule, the two major causes of plant electrical fires are overheating at loosened connection or contact areas of circuits, and electrical leakage. Nitto handles the former with yearly maintenance checks using thermography but the problem was in the latter case.

“We used to check the insulation monitoring equipment set up for each transformer but with multiple loads connected in parallel, it was difficult to pinpoint problem locations. And then, leaks through surface moisture would naturally dry and disappear while we were investigating, and we’d never find the cause.” commented Ueki.

## Summary:

As flammable liquids are used at the plant any electrical fault could lead to fire, but by using Mitsubishi Electric’s MELSEC-Q Series insulation monitoring module QE82LG, to monitor electrical devices and wiring for insulation deterioration, countermeasures have been strengthened without reworking major equipment.

## Key Points:

1. Rapid identification of leakage points has led to an efficient renovation process
2. Making use of existing facilities yet still enabling the rapid execution of electrical fire countermeasures
3. Continued safety improvement in parallel with cost reductions



In order to eliminate this kind of problem, what was needed was a system that could monitor leaks individually, close to the load and inform the supervisor immediately. Nitto turned to Mitsubishi Electric's insulation monitoring module QE82LG.

### Rapid identification of leakage of unknown origin is now a real possibility

As part of Mitsubishi Electric's general purpose PLC MELSEC-Q Series, the QE82LG module can measure leakage current for individual circuits. Notably, it can accurately monitor insulation deterioration through measuring the amount of resistance leakage current occurring due to wiring or device deterioration.

Nitto placed 30 QE82LGs in the transformer room and 22 in the cubicles of its Plant 2. The Zero-phase Current Transformer (ZCT) mounted on the cables at the base of the panel board is used to send leakage current information to the QE82LG which processes it.



Main display screen (left) and individual monitoring results display screen (right) on the GOT. Values exceeding the set threshold values light up in yellow or red.

# case study



The ZCT (1) mounted on the cables at the base of the panel board sends leakage current information to the insulation monitoring module "QE82LG" (2) within the panel board for processing.

Senior Technicians Mr. Ken'ichiro Nishiwaki (3) and Mr. Yoshiaki Sugimoto were also involved in the introduction process. "It's easier now to identify leakage points."

Senior Technician Mr. Shinya Ueki (4) says "I think we're going to be able to reduce maintenance costs at the same time as improving safety."

Measurement results are displayed on the GOT (Graphic Operation Terminal) display. The QE82LG allows two types of alarm threshold value to be set; in this case Nitto set an electric-shock level of 30mA and a potentially fire causing leakage-level of 200mA. If any of the total 52 monitoring devices should exceed these levels, even once, the GOT displays the leakage point in yellow or red and emits a warning.

By changing leakage monitoring from per-transformer to per-panel board, leakage causes which could not be determined in the past have now become increasingly clear. "For instance, once we had a case where the company doing wiring installation got the connection wrong, so that load current flowed onto the ground side. At the time we couldn't find the cause, but after introducing leakage monitoring, we've been able to identify causes immediately in similar cases," explained Ueki.

Furthermore, in cases involving phenomena like moisture-caused leakage (where the cause naturally evaporates) identification is now easily done at panel board level, meaning that it is now possible to renovate leakage points much earlier and prevent fire-related accidents. In addition, being able to see leakage current by circuit numerically is a saving grace for the maintenance staff. Ueki further explained "The usual practice is alarm-point management but being able to see the numbers all the time lets us grasp the status trends and respond more quickly."

The implementation costs fitted well within Nitto's budget. One major reason was that they were able to create the GOT display screens and monitoring programs themselves.

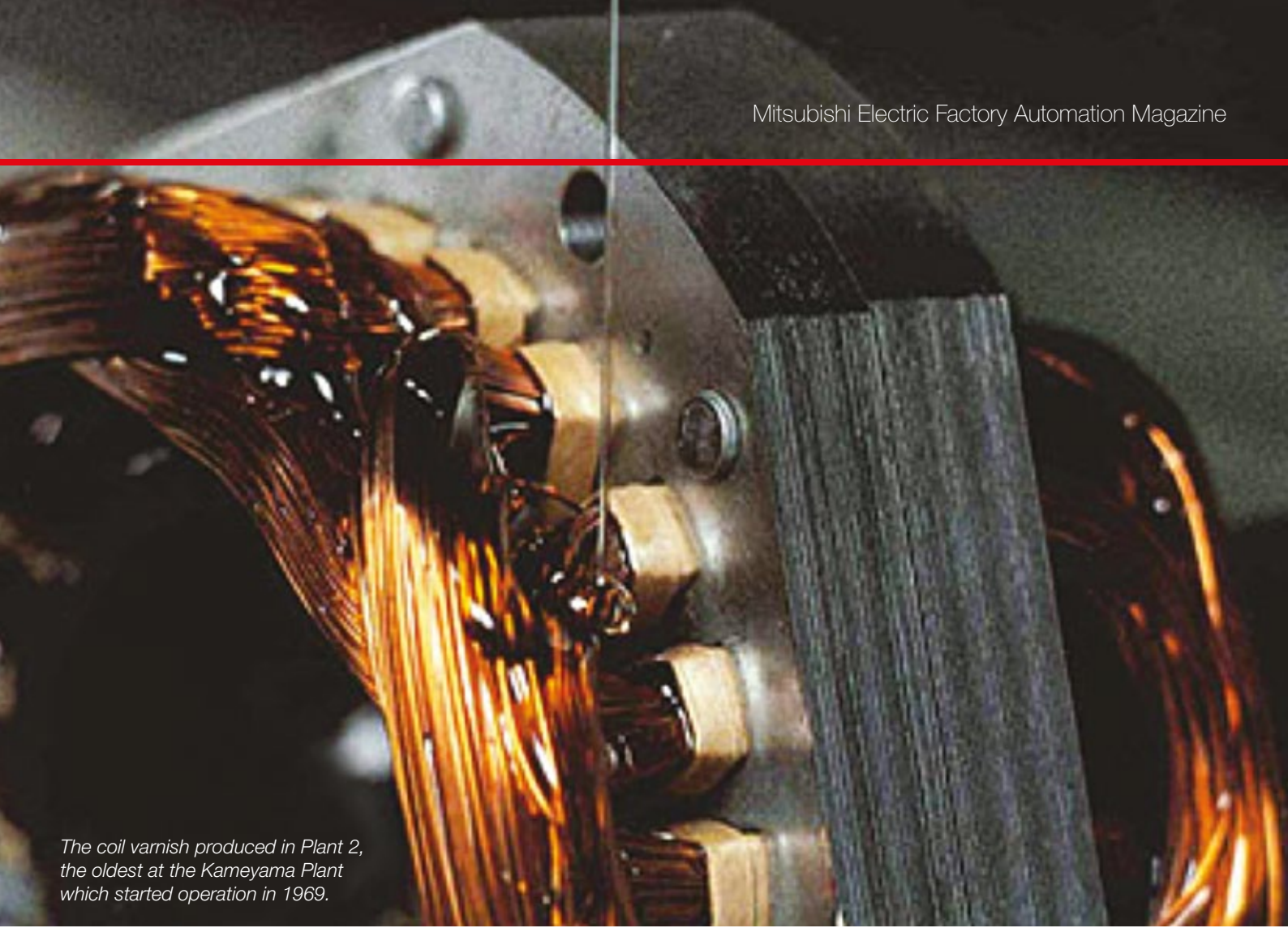
"By using the components provided by Mitsubishi Electric, the screen programming was completed in two weeks, and implementation took just a month, even with the rest of the design. If it had been something complex that we couldn't design ourselves, the costs would probably have soared," noted Ueki.

## Better organization of maintenance activities

Nor is fire prevention through insulation monitoring the only effect of the introduction of the insulation monitoring module. Another major advantage is its promise of future maintenance cost reduction.

Plants operating with more than 7,000V are required to name a chief electrical engineer and to present maintenance and safety regulations. Nitto's Kameyama Plant, also subject to these rules, is bound to observe strictly the regulations as presented and to prevent electrical accidents and failures. However, as the targeted facilities age, their risk of failure also increases, meaning that it is necessary to implement additional maintenance procedures along with more frequent conventional maintenance. As a result, the maintenance costs tend to increase year by year, and the process itself cannot be avoided.

However, "I have the feeling that we can replace a lot of our current maintenance process through new maintenance methods. Looking at the case of this insulation monitoring system we've introduced, maintenance activities measuring insulation resistance and so on of the panel board, were meant to confirm the state of the insulation of the devices and wiring, i.e. whether there's any leakage. I think [the new system] probably gives us good enough reasons to simplify it, reducing measurement frequency et cetera.



*The coil varnish produced in Plant 2, the oldest at the Kameyama Plant which started operation in 1969.*

"That is, by organizing the maintenance activity, we can both improve maintenance quality and reduce maintenance costs." suggested Ueki.

The fact is that when, as in the case of Plant 2, devices and wiring on site are used beyond the manufacturer's recommended replacement values, things can go wrong at any time.

A fixed cycle of maintenance may well not be enough to prevent accidents completely. What is essential is to have regular system monitoring which detects trouble more quickly and Nitto judged that insulation monitoring using the QE82LG would be effective in this vein.

Having confirmed the effects at Plant 2, Nitto now plans to consider introduction to other factories such as Plant 5. "Plant 5 started operation in 1985 and is about to hit 30 years old. Because it makes sealing resin for LEDs, it's full of powder<sup>1</sup>, and has a higher chance of leakage than other plants. We plan to move on with introduction while analyzing the insulation deterioration risks at other factories," concluded Ueki.

Looking ahead, they are envisioning future plans such as a system which would inform maintenance staff of alarms wirelessly from the PLC when a leakage occurs. The effects of the introduction of QE82LG's insulation monitoring for safety and security seem to be even greater than they had imagined. ■

“*In a very real sense energy, or more accurately Earth Leakage, has been used as an indicator of the health of the wiring. You could say that the energy was diagnosing the system, highlighting potential issues before they cause a major problem. Thank-you Dr. Energy!*”

**Monozukuri** ”

*Nitto Denko Corporation. Founded: October 25, 1918.*

*Business areas: Electronics, automotive, residential building materials, general industry, environment and health care.*

*URL: <http://www.nitto.co.jp/>*

*Note 1: Fine dust and powder can become combustible in high 'dust-to-air' concentrations creating a dust explosion; typically ignitable by electrostatic discharge, friction, arcing, hot surfaces and fire.*

Mitsubishi Electric is not only a designer and manufacturer of advanced automation products but is also a key user of them as well! That means we take great care that they are both robust, flexible and easy to design into any automation system that may present itself because we also want to use the best solutions possible.

Our automation products, renowned for their inspired design, superior construction and reliability – and designed for fast, easy installation – make engineering machine solutions far less challenging than it might have first appeared while keeping the user in total control.



## GOT2000 Series Rugged Model For Use Under Extreme Conditions (Human Machine Interface)

The Graphic Operation Terminal GOT2000 Series, a type of human-machine-interface (HMI), has added a 'Rugged' model to enable workers to monitor, operate and adjust machines that operate under extreme conditions, including very high temperatures, extra-bright lighting, strong vibrations or shock and high water pressures.

### Extra robustness and visibility for use under extreme conditions:

- Aluminum front panel for strong resistance to vibration and shock (more than double that of GOT2000 Series standard models).
- After installation the front panel is rated at IP66/IP67\*, allowing it to be washed down with high-pressure water.
- Withstands extreme ambient temperatures from -20° to +65° compared to 0° to 55° for standard models.
- Wide 7-inch TFT screen (WVGA: 800x480) with 65,536 colors for impressive displays.
- Improved screen visibility and extra outdoor durability (approx. 95% UV resistance).

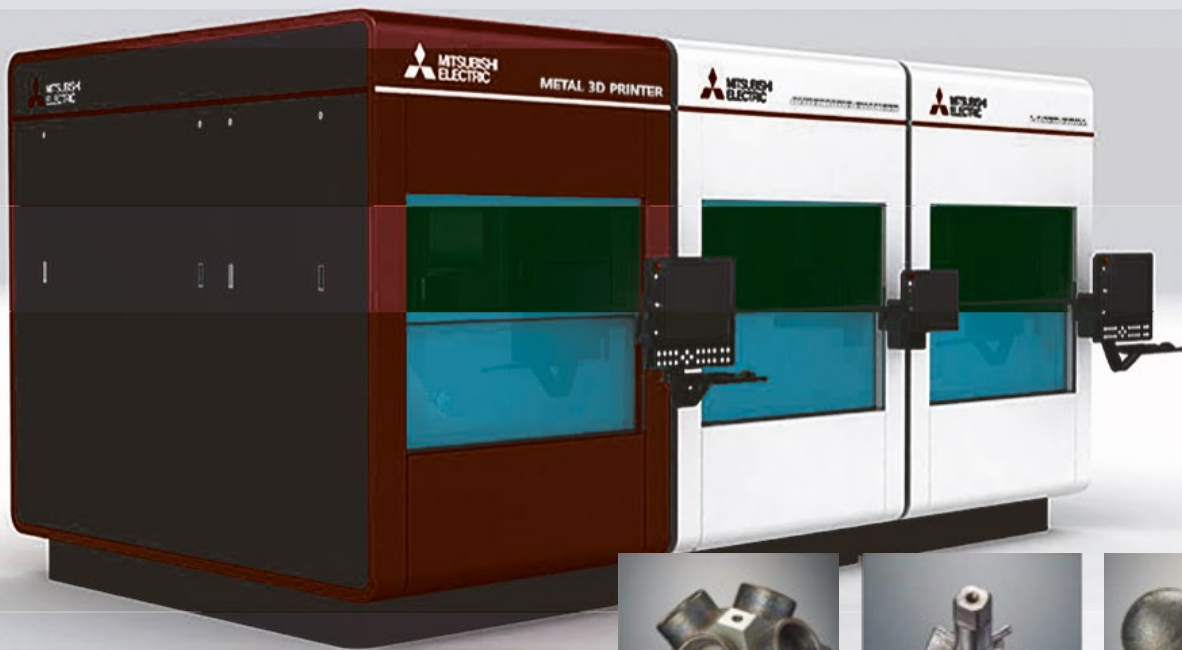
### Multiple communication interfaces for IoT worksites:

- Built-in Ethernet communication interface (Ethernet 2ch) for IoT integration.
- LAN module (optional) for wireless communication with PCs.

### Various functions to help reduce total costs and improve productivity:

- GOT mobile function to visualize overall state of facilities in real time using one or more remote devices (PCs, tablets, etc.) to reduce total costs at production sites.
- Audible warning function to help shorten downtimes and prevent misoperation.





*Metal forming shape examples.*

## New Dot Forming Technology Achieves High-precision Three-dimensional Metal Shaping (3D Printing)

Mitsubishi Electric has developed a unique dot forming technology that realizes high-precision shaping by combining laser, computer numerical control (CNC) and computer aided manufacturing CAM technologies in 3D printers. The technology produces high-quality three-dimensional (3D) parts with few voids at high speed, employing a laser wire directed-energy deposition (DED) method, which is an additive-manufacturing process that uses focused thermal energy to fuse materials as they are deposited. Mitsubishi Electric believes that its new technology will raise productivity in a wide range of applications, such as the 'near-net' (near-final) shaping of aircraft and automobile parts and build-up repairs.

### High-quality 3D parts formed at high speed:

- High-quality 3D parts with few voids can be formed at high speed using the laser wire DED method, which supplies metal wire directly to the laser-irradiated part for build-up shaping.
- A variety of 3D shapes are possible, including hollow or overhanging shapes.
- The technology can be combined with parts produced by other manufacturing methods and is therefore effective in build-up repairs.
- Common, proven and inexpensive laser-welding wire can be used.

### Improved shape accuracy through unique dot forming technology:

- Unique technique repeats spot forming by synchronously controlling the pulsed laser irradiation, the supply of metal wires and shield gas, and the shaping position. Shape accuracy is 60% more precise compared to conventional consecutive forming technology.
- Oxidation, a problem with the conventional technology, can be reduced by more than 20% compared to the conventional technology because high temperature areas are limited to a narrow spot forming area.
- Complex shapes can also be formed by using a special CAM processes compatible with dot forming technology.

# Taste<sub>of</sub> Japan

The all-encompassing Mitsubishi Electric family includes those who know quite a bit about Japan and those whose knowledge is possibly limited to geisha, samurai and Mount Fuji. So here, for the education and enjoyment of all, are some examples of the culture and art of Japan.



## Fire from ice

The future of energy remains an interesting and open-ended question and Japan, interestingly enough, may play a pivotal role in how that future shakes out. More than a decade ago, scientists in Japan discovered an energy resource that may prove to be incredibly useful in the future and we're not talking about oil. Quite the opposite, we're talking about flammable ice.

As noted by the BBC, the government in Japan is currently exploring the feasibility of using flammable ice as a common energy source. As the name alludes to, flammable ice is essentially a deposit of methane and frozen water.



## Onsen

An 'Onsen' is a Japanese cultural icon. The term refers to a hot spring and all of the facilities at them.

According to the Ministry of the Environment there are over 3,000 onsen areas in Japan with around 28,000 thermal fountainheads discharging approximately 2,700,000 liters of water every minute. Japan is literally floating on hot water! Many onsen are public day-use baths while there are also those used in private homes. Some baths are indoors and others outdoors. The diversity of local mineral waters are believed by many to have healing properties.





## Kotatsu

This is how the Japanese stay warm in the winter, or how you can stay in bed all day! The kotatsu consists of a blanket placed between a low table-frame and table-top, with a heat source placed underneath the blanket. With your legs placed under the blanket, someone wearing traditional Japanese clothing would have warm air come through the bottom of their robes and exit around the neck, heating the whole body.

The origins of the kotatsu can be traced to the 14th century Japanese irori, or cooking hearth. By the 17th century, irori dug into the ground, called hori-gotatsu, resembled a fixed kotatsu. Modern kotatsu, which are moveable, are referred to as oki-gotatsu. Since most Japanese homes have little insulation, kotatsu serve as effective space heaters during the cooler months.

# Did you know?

Mitsubishi Electric is pursuing their ninth biennial environmental plan, scheduled to end just before 2021, as it celebrates its 100th anniversary. Working symbiotically with the environment is a key value that underpins the company's intent to be a leading green company, hence the company's environmental statement:



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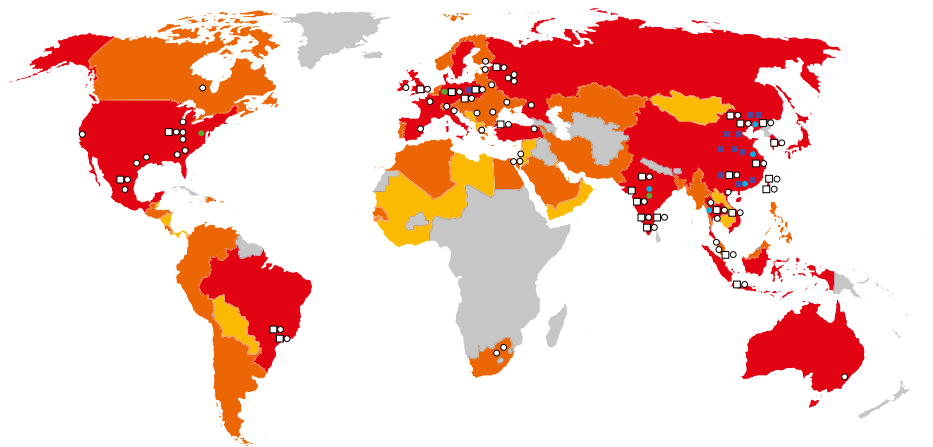


Power management meter



Energy measuring unit

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- 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 borders.

- A region where there are direct Mitsubishi Electric FA offices (main/local and satellite).
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