

THE ART OF MANUFACTURING



ものづくり

monozukuri

ISSUE 7

Mitsubishi Electric Factory Automation Customer Magazine

「QUALITY
CONTROL」

REDEFINING QUALITY CONTROL

A shift toward integrated
real-time solutions

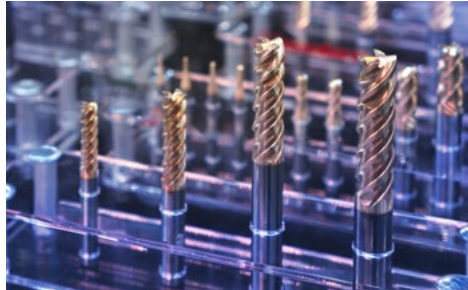
AI & REAL-TIME DATA ANALYTICS

Instant insights for
immediate action

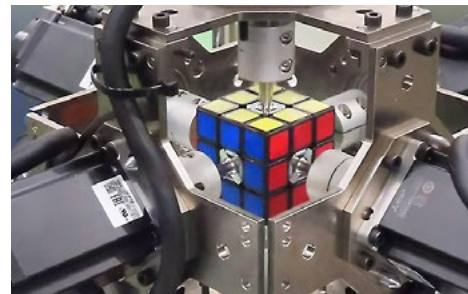
INTELLIGENT COMPONENTS

How IoT is revolutionizing
tool management

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Automating the world of 'quality'

No matter the industry, quality control is a crucial component in maintaining an excellent customer experience and ensuring that a business operates efficiently. However, the perception many have of quality control often stems from outdated stereotypes of manual inspection processes from a bygone era. The reality today is quite different.

In this edition of our Monozukuri magazine, we delve into how automation is transforming and enhancing every aspect of the quality control process. From high-speed visual inspections to detailed product traceability and closer integration with maintenance systems, automation is revolutionizing the way businesses approach quality assurance. This issue promises to be an insightful read, filled with compelling examples and perhaps even a few surprises along the way.

Automation isn't just a tool; it's a dynamic force that redefines standards of accuracy, efficiency, and consistency. By bridging the gap between human expertise and technological innovation, companies are achieving higher precision and driving forward their competitive edge. Whether you're new to automation or a seasoned expert, we believe you'll find something thought-provoking in this exploration of its growing impact on quality control. ■

Chris Hazlewood
Monozukuri
Editor in Chief



Redefining quality control

A shift toward integrated,
real-time solutions

Quality control has undergone a major transformation in modern manufacturing. What used to be a final inspection process is now a continuous, integrated function that touches every aspect of production. From the moment raw materials are sourced to after-sales support, quality management is an ongoing responsibility that drives efficiency, reliability, and customer satisfaction.

This shift reflects the growing complexity of manufacturing environments. As production processes become more automated and data-driven, traditional methods of quality control—relying on manual inspection and sporadic checks—are no longer adequate. Manufacturers are now adopting advanced software solutions, powered by machine learning and AI, that provide real-time insights and automation, enhancing both the accuracy and speed of quality management efforts.





Real-time monitoring for proactive quality management

Previously, quality control occurred post-production, identifying defects only at the end. This led to wasted time and resources when issues surfaced late. Today, real-time data and AI allow continuous monitoring, enabling immediate corrective actions and minimizing downtime through predictive maintenance.

Streamlining with advanced software

Modern software solutions centralize production data, automating tasks like data logging and compliance reporting, thereby reducing human error and freeing personnel for strategic roles. With machine learning, these systems continually improve, offering accurate predictions and faster response times to deviations.

Competitive advantage through quality

Today, real-time quality management is a competitive differentiator. Industries like automotive and aerospace benefit from AI-powered insights and predictive analytics, improving product quality, reducing downtime, and streamlining processes.

Ultimately, real-time, integrated quality management is key to building a resilient production process, transforming quality control from a bottleneck into a driver of operational excellence. Technology and automation are redefining quality control, minimizing errors and ensuring consistency at every production stage.

Beyond traditional inspections

Quality control isn't limited to product testing. While manufacturers often start with production processes, modern quality management is constantly evolving. Technology and automation are transforming what's possible. As the saying goes, "quality is a journey, not a destination." Over time, methods that once seemed sufficient may become inadequate, making it essential to leverage automation for consistency and to minimize human error. By automating repetitive or error-prone tasks, manufacturers can reduce the risk of oversight and improve quality at every level.

Let's explore some ways technology is redefining quality management

special feature

Visual inspection with a little help from AI



Speed meets precision

Visual inspection has been a cornerstone of quality control since the introduction of optical comparators in the 1920's. However, traditional methods often struggle with high volumes and fast-moving production lines. Coupled with shrinking workforces and escalating levels of over detection, maintaining quality in the visual inspection process at production sites has become increasingly challenging.

How do businesses address this?

Mitsubishi Electric VIXIO application examples:

1. Combining rule-based and AI-based inspections: Mitsubishi Electric MELSOFT VIXIO AI-based inspection reduces over-detection and misdetection and combined with existing rule-based inspection improves accuracy.

Rule-based-only inspection



Combination of rule-based and AI-based inspection



2. Performing primary screening with AI: Checking products identified in primary screening based on AI analysis is faster than traditional processes and reduces lead time.

Sorting by worker detailed inspection of defective products



Perform primary screening with AI



3. Double-checked by AI and humans: The introduction of double-checking reduces the risk of overlooking defective products and ensures consistency of quality between operations.

Visual inspection process by only one person



Double check by AI and workers



Visual Inspection Software MELSOFT VIXIO



<https://www.mitsubishielectric.com/fa/products/software/image-processing/vixio/index.html>

Today, advanced analysis solutions combined with inline camera sensors offer rapid, detailed surface inspections even for high-speed operations, which allows manufacturers to keep pace with production without sacrificing accuracy. For example, Mitsubishi Electric MELSOFT VIXIO software platform performs visual inspections in coordination with external camera sensors and offers all the necessary functions for a visual inspection system along with easy set up and without the need for programming.

Historically, large amounts of defective product imagery were needed to achieve reliable quality control in optical comparator systems. However, AI learning now enables the generation of highly accurate models, even from just a few reference images, and high-speed learning capabilities minimizes the trial and error associated with the set-up process.

Camera operation can either be linked to a PLC during on-site operation for real-time analysis or used for creating inspection results monitoring screens and quality control data for later use – all achieved using AI, that avoids the need for supplementary, complex and time-consuming programming. In addition, inspection results and production data can be linked to a centralized control, which ensures traceability in the inspection process and also aids analysis by extracting and visualizing key data no matter the source.

Mitsubishi Electric MELSOFT VIXIO was specifically developed to meet the challenges of manufacturing and offers easy device linking, AI model generation, inspection, monitoring and traceability – all integrated into one software package.

Revolutionizing visual inspection with solutions like Mitsubishi Electric MELSOFT VIXIO, manufacturers can utilize AI for primary screening in all-product inspection processes, and subsequently only need to visually inspect the defective products manually once they have been identified, potentially saving whole batches of product during the manufacturing process. Moreover, its application for inspection tasks such as determining color irregularity, foreign object detection and multiple-view visual inspections contributes in reductions to over detection, making the quality control process faster and more cost-effective. ■

Look to perfect traceability

Linking quality to every part

As products grow in complexity, ensuring traceability across the production process is key to maintaining high quality standards. Mitsubishi Electric's GENESIS64™ SCADA solution addresses this need by offering real-time visibility into every component from origin to destination. For manufacturers like Linkstech, this feature has been instrumental in improving both operational efficiency and quality control.



By integrating factory layout data into the dashboards, GENESIS64™ generates intuitive and easy-to-understand screens.

SCADA's role in traceability

Traceability is more than a regulatory requirement; it is essential for meeting customer expectations and enhancing operational transparency. SCADA software Genesis64™ allows real-time monitoring, visualization and analytics, providing manufacturers with the tools they need to ensure that every part and process can be tracked seamlessly. This level of detail helps pinpoint potential issues early, making preventive actions faster and more effective. For example, Linkstech's Shimodate Plant, which previously relied on manual checks, has seen a significant transformation since implementing SCADA software Genesis64™. By leveraging the software's real-time capabilities, the plant now monitors the production status instantly, linking quality metrics directly to each part produced.



Linkstech used GENESIS64™ to develop its own dashboards and screens.

Implementing real-time monitoring

The Shimodate Plant deployed SCADA software GENESIS64™ to automate and streamline its production processes. Previously, the plant relied on manual tracking, which led to delays and inaccuracies. With GENESIS64™, it developed a flexible control system tailored to its needs, enabling real-time production visualization and immediate detection of irregularities.

This transformation has enhanced productivity and bolstered quality assurance. A key benefit is seen in the plant's wastewater treatment monitoring, especially for pH levels. Formerly a manual process, real-time pH tracking now lets the plant proactively address issues, preventing production impacts and maintaining environmental compliance.

Perfecting traceability for quality assurance

Traceability is critical for complex products with multiple components, where lapses can cause downtime and quality problems. With SCADA software GENESIS64™, each part's journey is meticulously recorded, allowing swift identification and isolation of defective components and minimizing production disruptions.

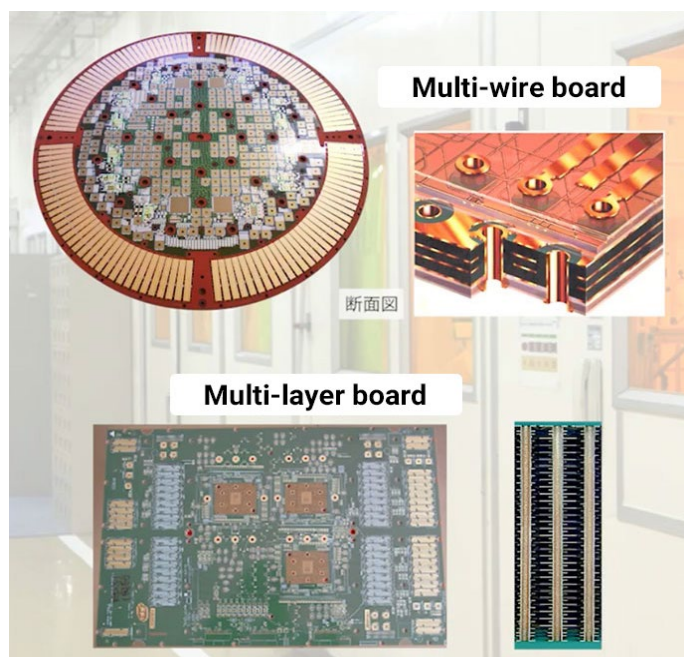
Real-time traceability is essential not only for product quality but also for regulatory compliance. For Linkstech, this level of traceability has been transformative. By linking quality control directly to production stages, the company swiftly identifies defects and takes corrective actions, improving product quality and maintaining high customer satisfaction.

Delivering real-time visualization and connectivity

SCADA software GENESIS64's™ ability to make 'the invisible visible' is not limited to just production processes. The software delivers mobility, allowing operators and managers to access real-time data from any location, whether on the shop floor or remotely. The seamless connectivity offered enables integrated operations across different systems, ensuring that all departments within a facility can work together with the same up-to-date information.

For Linkstech, this has meant enhanced collaboration between different teams responsible for production, quality control and environmental compliance. With a clear, real-time view of production status and the ability to take preventive actions before issues arise, the plant has optimized its operations and minimized disruptions.

Mitsubishi Electric's solutions play a critical role in supporting manufacturers like Linkstech as they strive to meet the increasing demands for product traceability and quality assurance. With real-time visualization, comprehensive traceability, and seamless system integration, it allows manufacturers to optimize their operations while maintaining the highest quality standards. Linkstech's Shimodate Plant exemplifies how leveraging advanced systems can lead to significant improvements in both production efficiency and product quality, allowing manufacturers to thrive in the evolving landscape of smart manufacturing. ■



Lincstech manufactures multi-layer and high-density wiring boards for manufacturers of smartphones, vehicles, and robots.

GENESIS64™ Users Voice



Lincstech visualized its real-time production status using Mitsubishi Electric's GENESIS64™ SCADA software.



https://www.youtube.com/watch?v=pSNo_HrtMXg

SCADA software GENESIS64™



<https://www.mitsubishielectric.com/fa/products/software/visualisation/genesis64/index.html>

Transforming manufacturing with real-time data and AI-driven insights

In today's fast-paced manufacturing environment, staying competitive means addressing challenges like equipment maintenance, quality control, and knowledge transfer more efficiently than ever before. Real-time data processing is revolutionizing how manufacturers approach these issues, enabling teams to detect and address problems as they arise directly on the production line.

Thanks to advanced tools like Mitsubishi Electric's MELIPC and RTDA (Real Time Data Analyzer), manufacturers can now leverage AI-driven analytics to streamline operations. These systems analyze data on the spot, delivering actionable insights without requiring a background in data science. This means quicker decision-making, reduced downtime, and higher-quality outputs, all while minimizing reliance on specialized expertise.



The data analysis software MELSOFT MaiLab enables data utilization without special knowledge.

Key benefits of AI-powered analytics in manufacturing

- **Automated decision-making:** By digitizing the expertise of skilled workers, AI ensures consistent quality and empowers teams to make informed decisions across production lines.
- **Predictive maintenance:** AI identifies optimal replacement schedules for consumables and anticipates equipment failures, preventing costly breakdowns and maximizing operational efficiency.
- **Enhanced quality control:** Through advanced data analysis, AI minimizes variability in inspections, delivering consistent and improved product quality.



Ease of use and accessibility

Modern AI platforms are designed with user-friendliness in mind, enabling even those without prior experience in data analysis to harness their potential. These solutions integrate seamlessly with existing production systems, providing intuitive interfaces for real-time monitoring and diagnostics. Manufacturers can customize and scale these tools to fit their specific needs, ensuring a tailored approach to operational challenges.

A game-changer for manufacturers

With tools like MELSOFT Mailab, AI is no longer confined to experts. This powerful platform bridges the gap between complex data analysis and day-to-day manufacturing needs, allowing teams to predict issues, optimize workflows, and drive innovation. By adopting such solutions, manufacturers can unlock the full potential of their data, ensuring a future-ready, efficient, and resilient operation.

MELSOFT Mailab is setting a new standard for accessible AI in manufacturing, making sophisticated analytics a practical reality for businesses of all sizes. ■

Lotte case study

Real-time millisecond level data acquisition and analysis



<https://www.mitsubishielectric.com/fa/our-stories/013/index.html>



Data science tool MELSOFT Mailab



<https://www.mitsubishielectric.com/fa/products/software/data-science-tools/mailab/about/index.html>

Empowering manufacturing

Simulating and visualizing processes in advance

Digital twins and simulation software like MELSOFT Mirror and MELSOFT Gemini enhance quality management by enabling manufacturers to simulate production scenarios and predict issues before they occur. Event replay features allow analysis of past problems by linking video to automation code to offer deeper insights.

As the manufacturing industry faces increasing challenges, integrating digital technology streamlines processes and improves production. Mitsubishi Electric aims to bridge the gap between digital and real-world applications, while driving its manufacturing solutions forward. This evolution in manufacturing is explored with insights from Kazuya Mizushima, who has held several key positions in Mitsubishi Electric including serving as General Manager of the FA Digital Engineering Department.

The rising relevance of dynamic capability

The global manufacturing sector faces challenges like geopolitical tensions, rising costs, carbon neutrality demands, and workforce shortages. To navigate these, businesses must strengthen dynamic capabilities, with digital transformation seen as vital for enhancing adaptability and resilience.

Mizushima notes; simulation technology is vital for streamlining production lines and reducing construction times. By linking data across organizations, businesses can leverage AI for insightful analysis. This shift to digital manufacturing enhances efficiency, flexibility, and resilience by integrating technology into production processes. Creating responsive systems that align projections with actual results using comprehensive manufacturing data is becoming increasingly important. The manufacturing process is closely tied to engineering and supply chains, encompassing everything from product design to delivery. By collecting data from these activities, companies can refine processes, visualize discrepancies, and improve operational efficiency, ultimately reducing costs and enhancing quality.

*Kazuya Mizushima
Former General Manager of the FA
Digital Engineering Department*

Solutions for the manufacturing lifecycle

Mitsubishi Electric's manufacturing solutions leverage real-world expertise, using simulation software to align models with actual conditions. The MELSOFT Gemini simulator, a key tool, employs 3D virtual simulations to evaluate system designs, reducing the need for costly on-site assessments and enhancing efficiency by comparing pre- and post-operation data.

Recognizing the growing need for simulation in sectors like automotive and electronics, Mitsubishi developed MELSOFT Mirror in 2024. Unlike Gemini, MELSOFT Mirror can simulate the entire control system of a manufacturing site, streamlining complex assessments. This reduces the time required for on-site adjustments after malfunctions, significantly shortening production schedules.

MELSOFT Mirror also facilitates real-time collaboration among global users, enhancing design and assessment processes and underscoring the need for digital manufacturing to transcend simple simulation and focus on aligning projections with reality by maximizing data use throughout the manufacturing life-cycle.

In addition to simulation tools, Mitsubishi Electric offers SCADA software GENESIS64™ for visualizing manufacturing data and MELSOFT MailLab for AI-driven data analysis, both aimed at improving production accuracy and bridging gaps between simulated and actual results.

The strength behind Japanese manufacturing

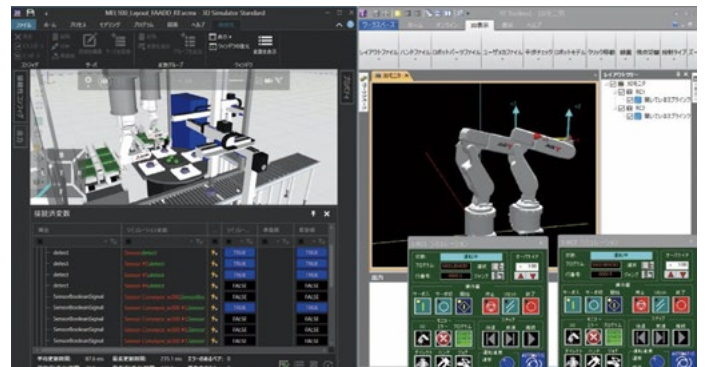
As global manufacturing navigates a digitalized world, it is also grappling with labor shortages and a shrinking pool of younger workers that can inherit technical expertise. Digital manufacturing holds the key by addressing the reality of declining birth rates and an aging population.

"Compared to companies at the forefront in the West, digital transformation in Japan has lagged in certain aspects," Mizushima comments. For manufacturers looking to embrace digital manufacturing and evolve accordingly.

"Mitsubishi Electric provides the tools for digital manufacturing, but having the full set doesn't guarantee immediate efficiency improvements. Without people using AI-driven insights to enhance operations, transforming production sites will remain difficult. Similarly, accurate simulations require virtual environments built by those who understand the intricacies of the sites. Success in digital manufacturing depends on combining technology with the knowledge and expertise of skilled people, allowing our strength in manufacturing to truly shine.

"Using human expertise to enhance manufacturing data and technology will drive flexibility and efficiency, but it's important to recognize that every production site is unique. The manufacturing industry encompasses various fields, operation scales, and business philosophies."

MELSOFT Mirror represents a significant leap in manufacturing technology, enabling companies to optimize operations, cut costs, and enhance quality through digital twin simulations. Mitsubishi Electric envisions a future of flexible, collaborative, and continuously improving manufacturing, with MELSOFT Mirror playing a central role in helping businesses stay competitive as the industry evolves. ■



People are the very cornerstone of Japanese manufacturing. Workers on each production line repeatedly test their hypotheses, perfecting each process and the technology involved. Productivity increases because people implement these improvements; in the process, these workers acquire unique skills and knowledge themselves.



Kazuya Mizushima
Former General Manager of the FA
Digital Engineering Department

3D simulator MELSOFT Gemini



<https://www.mitsubishielectric.com/fa/products/software/simulation-tools/gemini/index.html>

3D logic simulator MELSOFT Mirror

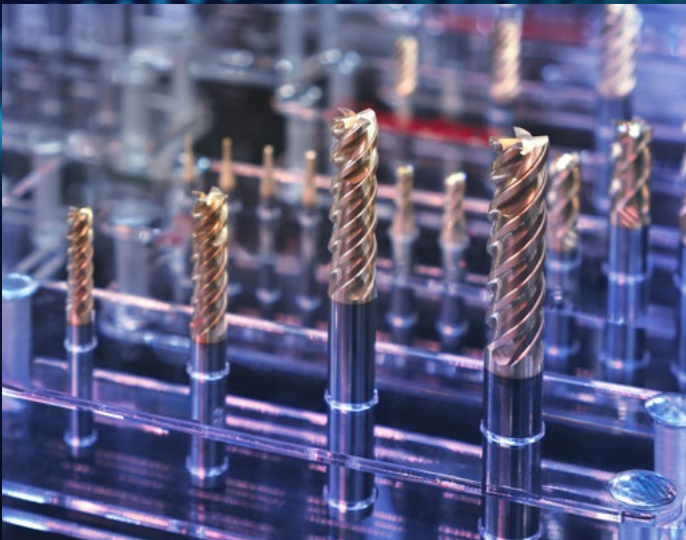


<https://www.mitsubishielectric.com/our-stories/articles/biz-t/melsoft-mirror/>

Intelligent components

How IoT is revolutionizing tool management

In factories, the cutting tools used in machining, are considered almost a consumable part. However, their performance and operational life can have a big impact on production costs, so keeping a close eye on their condition is no bad thing. In parallel, after all the hype around IoT and how it will revolutionize manufacturing, there are still relatively few practical use-cases with justifiable ROI. Hiroshi Nishiyuki, Head of Mitsubishi Electric's FA System Solutions Department, explains how these conditions converged and resulted in solving both problems.



Electric shavers and machine tools share a commonality: their cutting tools require occasional replacement. Hiroshi Nishiyuki explains that, like many, he sometimes neglects his shaving routine and using a worn blade can compromise his shave. He reflects on the daily growth of men's beards, noting the appeal of the shaver industry, where blades are consumable products similar to toner in copiers.

In contrast, machine tool cutters are significantly more expensive, so holding stocks of spare cutters is not economical. However, the condition of these tools directly affects the quality of machined parts and unexpected downtime due to worn cutters increases costs and poses challenges. The question then becomes can IoT be used to solve these problems?

IoT is not the solution to everything

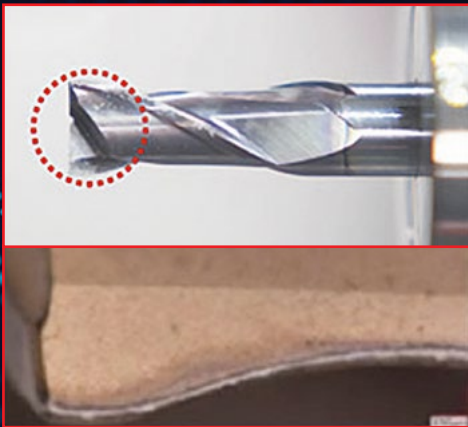
"It is not widely known that implementing IoT on factory floors is quite difficult," says Nishiyuki. "What's making things difficult to understand is the complexity of determining the ROI." Some of you may have tried using IoT in a proof of concept, but possibly figured it would be too expensive and with little benefit.

Failures in IoT implementation can stem from a lack of specific KPIs or from not achieving expected outcomes despite having set KPIs, such as improving product yield and reducing costs. IoT and AI aren't universal solutions; they help identify relationships between outcomes and their causes. However, discovering these connections often involves trial and error, which is labor-intensive and costly. Without a clear method to improve yield, investments in IoT for cost reduction may instead turn into research and development expenses, leading to budget overruns.

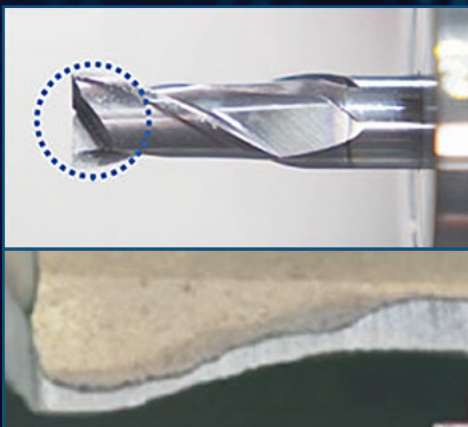
Is there a way to replace tooling without wasting money?

To address challenges in machine tool management using IoT, it's essential to implement proven solutions. A key consideration is whether IoT can reduce machining defects and tooling replacement frequency, along with understanding the necessary investment. Evaluating the expected ROI before committing to IoT is crucial.

"It is not widely known that implementing IoT on factory floors is quite difficult. What's making things difficult to understand is the complexity of determining the ROI."



The sharp cutting edge of an end mill.



A worn/blunt edge by comparison.

Hiroshi Nishiyuki emphasizes the extensive experience in collecting and analyzing IoT data, which has led to the development of tools for effective tooling management and quality control. One such tool, the *iQ Monozukuri Machine Tool Wear Diagnosis (iMMTWD)*, helps users determine optimal tool replacement times, prevent unexpected tool failures, and easily leverage data. Customers who adopted this solution have significantly reduced machining defects, with some achieving up to a 40% decrease in annual tool costs, thus demonstrating ROI – previously a barrier to IoT investment.

Nishiyuki concludes, "The post COVID-19 manufacturing environment has made it difficult to produce products that rely on the experience and know-how of skilled workers, on the other hand the adoption of IoT is accelerating more than ever before. Therefore, for those who want to utilize IoT, or have already introduced it but have not yet found it effective, I recommend using tool wear diagnosis solutions that will lead to tangible results." ■

Read the full article here



<https://www.mitsubishielectric.com/fa/the-art-of-manufacturing/column/the-inside-view03/index.html>

News from around the world

SWEDEN

Automation helps to reduce food waste in Radisson Blu Scandinavia by approx 100%

Product Innovation

Mitsubishi Electric technologies have enabled the development of innovative composting machines that can turn food waste into high-quality fertilizer in just 24 hours. This solution responds to the global problem of waste, in particular food waste, which constitutes about 30% of landfill waste*. For Radisson Blu Scandinavia, this technology enables the daily processing of food waste from restaurants, room service, and other food-related operations.

“What once took a year to complete can now be achieved in just 24 hours, significantly improving efficiency and sustainability. This solution represents a major step forward in waste management and environmental protection. By transforming food waste into valuable fertilizer, Mitsubishi Electric, and Solserv AB, bio solutions provider, are contributing to a more sustainable and circular economy, addressing both waste reduction and soil enrichment challenges” – explains Maria Wendt, Marketing Communication Manager at Mitsubishi Electric Scandinavia.

* <https://greenly.earth/en-us/blog/ecology-news/global-food-waste-in-2022>



Would you like to be featured in the next edition of monozukuri – The Art of Manufacturing? **Get in touch and share your success story.**

VIETNAM

Establishment of Vietnamese joint venture for FA products announced

Partnership

Mitsubishi Electric Corporation announced that it will acquire an 80% stake in Fuji Bakelite Vietnam Co., Ltd. in the outskirts of Hanoi, a subsidiary of Fuji Bakelite Co., Ltd. in Okayama Prefecture, Japan. The new joint venture (JV) company will be established on June 1 and will begin production of air circuit breakers from January 2025, in addition to the current company's existing line of small low-voltage circuit breakers.

Fuji Bakelite Vietnam, which has been in operation since 2014, manufactures small low-voltage circuit breakers for Mitsubishi Electric's Fukuyama Works in Hiroshima Prefecture. The new JV will leverage Fuji Bakelite Vietnam's skilled workforce and expertise in manufacturing and quality control in Vietnam in its manufacturing operations.



TAIWAN

1st Taiwan MECA student engineering competition

Education support

On March 8, 2024, Setsuyo Taiwan, Mitsubishi Electric Group held the finals of the 1st Taiwan MECA Educational competitions in collaboration with industry, academia and government at the National Taipei University of Technology's. 40 student teams entered from universities and technical colleges across Taiwan, including many innovative smart manufacturing applications using Mitsubishi Electric's FA products. The following works were selected under rigorous judging:

Winner: “Monitor carbon emissions/ Reduce energy consumption & costs”

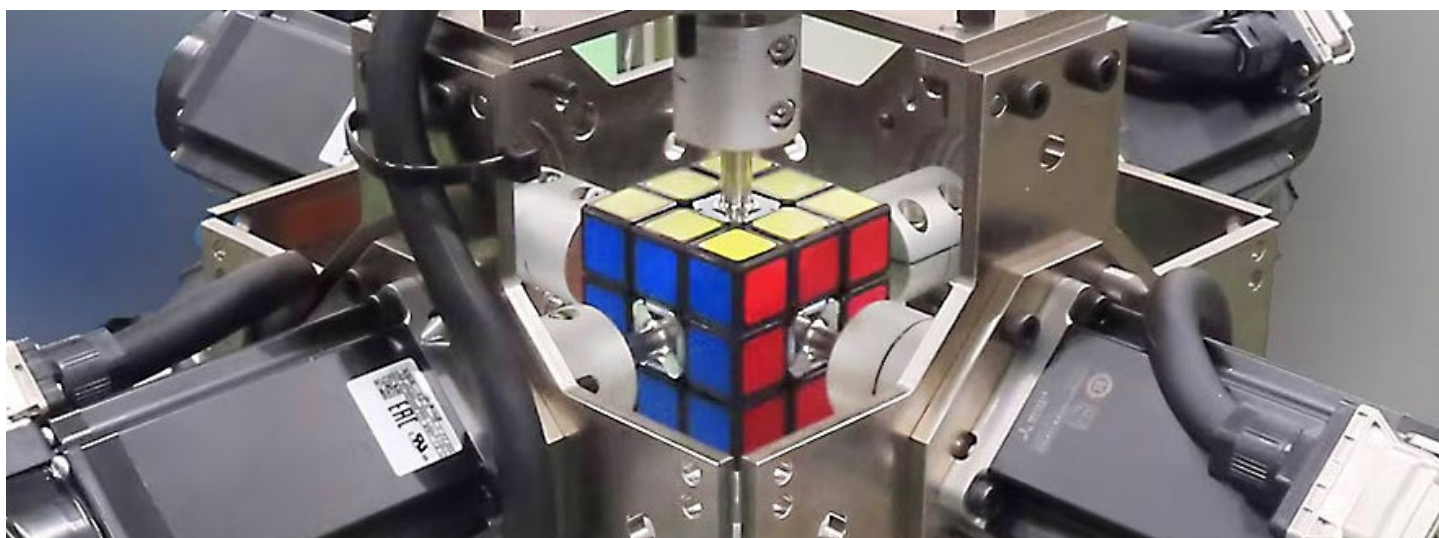
Runner-up: “Precision machining equipment/ Intelligent control of Thermal equilibrium”

3rd place: “Automatic inspection for defects in bearing manufacturing process”

* MECA is Mitsubishi Electric FA educational support activity for students around the world.



0.305s – Record-breaking achievement



Mitsubishi Electric recognized by Guinness World Records™ for the fastest robot to solve a puzzle cube.

In May 2024, Mitsubishi Electric was awarded the Guinness World Record™ title for the fastest robot to solve a puzzle cube using a robot equipped with high-speed, high-precision factory automation equipment and control technology. The robot's time of 0.305 seconds beat the previous record of 0.38 seconds.

The TOKUI Fast Accurate Synchronized Motion Testing Robot (TOKUFASTbot) achieves a 90° rotation in just 0.009 seconds using Mitsubishi Electric's advanced servomotors and a proprietary AI-based color-recognition algorithm. Its components include a programmable controller, industrial PC, and cameras, that enable high-speed communication and control.

Yuji Yoshimura, Senior General Manager, Component Production Engineering Center, Mitsubishi Electric said, "Since 2016, we have been developing and manufacturing high-tech motors, power semiconductors and related products. To demonstrate our technical capabilities in achieving high-speed, high-precision windings, which are key to increasing the productivity and efficiency of motors used in many of our products, our young engineers volunteered to attempt the world record."

The record was achieved using compact, high-power servomotors in the rotation mechanism. Advanced components like programmable controllers, PLCs, and touch panels enable high-speed signal connection and control. An AI-based color-recognition algorithm allows for instant color identification, even with variations in block positions or shadows, effectively distinguishing between red and orange blocks. The program analyzing the rotation procedure for matching block colors has been optimized to enhance processing speeds, contributing to the world record.



The project team with the Guinness World Records™ certificate in Hyogo, Japan.

Process management

Preventing issues before they happen

Machine operation and maintenance are crucial for preventing quality lapses, as machinery and human error can cause issues even with consistent raw materials. Mitsubishi Electric's automation solutions enable predictive maintenance and support operators in following correct procedures. This structured guidance, combined with step-by-step logging, enhances quality management, embodying the Poka Yoke approach to eliminate errors and maintain high standards.



A light comes on to show which box components should be taken from.



The display unit shows details of screw locations and sequence to prevent mistakes.



Lights on each screwdriver come on in the order in which they should be used.



Cellular manufacturing facility producing PLCs and GOT HMIs.

Clear work procedures improve productivity and quality

Mitsubishi Electric's Nagoya Works E4 production site utilizes e-F@ctory technologies for enhanced operational visualization and energy savings, focusing on quality, productivity for new workers, and easing the load on experienced operators.

Introduction to the Nagoya Works – E4 cellular manufacturing line

To maintain high product quality and productivity, strict assembly procedures are essential. Mitsubishi Electric's Guided Operator Solutions (GOS), used for over ten years, accommodates various PLCs and display units, allowing flexible production adjustments. While this approach enables adaptability, it also introduces potential for human error. In the cellular manufacturing facility where PLCs and GOT HMIs are produced, incremental improvements have significantly reduced operator-related product failures to one-tenth over the past decade. To further enhance quality, the 5th floor of the E4 building has been upgraded with e-F@ctory technology, aiming to minimize errors and improve overall production standards.

Different screws and screwdrivers for different purposes

In assembling PLCs, some models require up to 16 screws of five types tightened with four screwdrivers, complicating the process for less experienced workers. Mikio Iijima, Senior Manager of Factory Automation, notes that skilled workers spend significant time training new employees. To streamline this, Mitsubishi Electric implemented a new production system to assist inexperienced workers by ensuring they use the correct components and mount them properly, reducing the need for extensive guidance from skilled personnel.

Showing workers where to find components

Mitsubishi Electric's GOS system ensures operators select the right components through production instructions, display units, and guide terminals. When workers scan bar codes, the system shows the required components and automatically opens the appropriate screw box, minimizing selection errors.

After gathering screws, the display guides proper mounting, with lights indicating the correct screwdriver to use. Each screwdriver is set to the optimal torque to prevent errors.

Mikio Iijima highlights that this system standardizes processes across locations, improving quality and adherence to procedures. Additionally, controller data is stored for traceability, enhancing operational consistency and overall product quality.

Improvements based on accurate data

Mitsubishi Electric's system improves part selection and usage, reducing the training burden on experienced workers and facilitating on-site enhancements. Mikio Iijima explains that screw tightening failures prompt the team to investigate and implement quality improvements. Identifying skill gaps allows for targeted training, while persistent failures indicate potential procedural issues needing refinement.

The system automatically collects work-related data, essential for the Kaizen continuous improvement process. This data helps identify improvement areas and verify changes' effectiveness. By integrating FA and ICT equipment, e-F@ctory provides vital on-site data, emphasizing that adapting techniques to local practices is crucial for effective productivity and quality improvements.

An ever-evolving system

The E4 site is quickly evolving its system, now integrating real-time screw quantity checks. This method weighs boxes after screws are removed to assess stock levels and automatically orders replacements based on demand. This integration is made possible by linking the FA system with ICT systems for production planning and inventory management.

Additionally, the site utilizes cameras to measure and analyze screw tightening times, helping to identify variations. If tightening times do not correlate with worker proficiency, it suggests inefficiencies from other factors. e-F@ctory solutions facilitate extensive data measurement and analysis, opening endless development opportunities. ■



Martinshof Werkstatt case study

Guided Operator Solutions has empowered our workers

<https://www.mitsubishielectric.com/fa/our-stories/009/index.html>



special feature

Testing to the limits

In the automotive industry, rigorous testing is essential to ensure both safety and quality. Non-destructive testing (NDT) and destructive testing (DT) serve as crucial methods, with Mitsubishi Electric providing cutting-edge automation solutions for both.

Battenberg case study

Mitsubishi Electric's solutions help manufacturers reduce waste, improve testing accuracy, and maintain high quality standards. Read how Battenberg achieved cost-saving for their customers.



<https://us.mitsubishielectric.com/fa/en/resources/case-studies/assets/battenberg/>



Non-destructive testing

This approach enables manufacturers to inspect component integrity without damaging them, detecting issues in structural and safety parts. Using products such as Mitsubishi Electric's MELFA robots and iQ-R PLCs, optimizes the speed and accuracy of these NDT processes. Through solutions like Battenberg's haptic systems, Mitsubishi robots mimic human movements in real-time, precisely measuring forces for quality assurance. Such precision has led Battenberg's systems, featuring Mitsubishi's RV-7F robot, to gain comprehensive acceptance in the automotive industry due to their adaptability and standardized testing capabilities.

Automated NDT ensures high production volumes without sacrificing quality, supporting real-time inspection for components, eliminating human error and increasing reliability. Mitsubishi Electric's products also align with customers' sustainability efforts by minimizing waste and energy use. With adaptable, data-driven technologies, manufacturers are able to meet evolving industry needs.

Destructive testing

For evaluating component durability under stress, DT subjects parts to extreme conditions until they fail, providing insight into material robustness. Mitsubishi's robotic systems enhance DT accuracy and consistency, especially in the repetitive testing of parts like seatbelts or suspension systems. Automating these processes not only streamlines testing but also enables real-time data collection, crucial for informed design adjustments and efficient production.

Mitsubishi Electric's automation systems, including MELFA robots and SCADA systems, automate DT processes, delivering consistent results through repeatable, controlled tests. For high-stress tasks, like door durability or cyclic load testing, Mitsubishi Electric's robotics and data analysis tools ensure precision, collecting real-time data on failure modes and wear patterns. Automated DT supports faster, more reliable testing cycles, allowing manufacturers to validate both traditional and new materials – critical as the industry adopts lightweight composites and advanced alloys for electric vehicles. ■

Energy as a leading indicator

Energy consumption is more than just an operational cost – it can also be a key indicator of potential issues. Undetected spikes in energy usage could, for example, signal mechanical wear and tears that, if left unchecked, could lead to equipment failure.

Mitsubishi Electric's EcoAdviser, an energy saving support tool helps manufacturers monitor energy use as a diagnostic tool, highlighting areas where preventive maintenance may be necessary.



Energy usage per unit produced can serve as a key Factory Management Index

Energy saving support software
EcoAdviser



https://www.mitsubishielectric.com/fa/products/pmng/ems/smerit/eap/eap_2.html

Mitsubishi Electric's Fukuyama Works develops and manufactures circuit breakers and measurement & control devices. Encased in molded plastic, their production consumes significant amounts of energy and highlights the need for efficient energy-saving measures during manufacturing.

With assistance from EcoAdviser, staff at the plant visualized data, identifying the curing furnaces (industrial oven) as the primary energy consumer. Analysis revealed low input efficiency, prompting a change in the production plan. By using AI diagnostics, this tool discovered that the furnaces' startup times and idle energy consumption during lunch breaks were key loss factors. Based on the EcoAdviser's recommendations, startup was delayed from 10:00am to 11:00am to reduce downtime and AI also flagged other inefficiencies, such as a 7:00am furnace start versus an 11:00am production start, revealing the furnace's startup time was 30 minutes earlier than needed. Adjusting the schedule to delay startup improved operations.

When energy across furnaces was examined, the problem was discovered that one consumed three times more energy than the others due to an improperly adjusted exhaust damper, causing excessive heated air leakage and power waste. This finding led to repairs being made to the dampers across all the curing furnaces, further improving energy efficiency. Optimization using Mitsubishi's EcoWebServerIII and EcoAdviser tools also brought substantial energy savings that would have been challenging to detect manually.

By implementing the solutions, energy costs were reduced by approximately 1.4 million yen (\$10,000) annually. ■

Did you know?

Mitsubishi Electric played a foundational role in establishing the Mount Fuji Weather Station's radar system, contributing advanced technology to improve Japan's typhoon monitoring capabilities and save lives.



The radar dome reaching the summit in 1964 amid turbulence – even veteran pilots feared for their lives. (Photo: Mitsubishi Electric)

Following the devastating 1959 Isewan Typhoon, which claimed over 5,000 lives, the Japan Meteorological Agency (JMA) tasked Mitsubishi Electric with installing a radar at Mount Fuji's summit to enhance early typhoon detection. The project, completed in 1964, not only marked a significant advance in weather technology but also set new standards for durability and remote operations.

Construction of the Mount Fuji Radar System began in 1963, facing considerable challenges due to the mountain's harsh environment. Workers contended with altitude sickness, extreme weather, and frequent lightning strikes while transporting materials and constructing on Japan's highest peak. Despite these obstacles, Mitsubishi Electric completed the radar installation on the Kengamine ridge by October 1964, creating the world's highest and longest-range weather radar at the time. The system's remarkable range of 800 kilometers enabled it to detect typhoons at unprecedented distances.

This pioneering radar provided Japan with critical early warning capabilities, significantly improving disaster response. Mitsubishi Electric's technology introduced innovations in remote control, allowing JMA to operate the radar from over 200 kilometers away in Tokyo. This long-distance control system, essential in the extreme conditions of Mount Fuji, became a benchmark for durable and low-maintenance radar systems worldwide.

With the launch of the Himawari geostationary meteorological satellite in 1977, Japan transitioned to satellite-based typhoon monitoring, gradually reducing reliance on ground-based radar. The Mount Fuji Radar System remained in operation until 1999, when it was decommissioned, and its distinctive white dome dismantled in 2001.

The legacy of the Mount Fuji Radar System continues to be celebrated, receiving an IEEE Milestone award in 2000 in recognition of its historical significance in electrical and electronic engineering. Since 2007, a nonprofit organization, the Mount Fuji Research Station (MFRS) preserves the site's scientific legacy. ■

3,776m
above sea level

detection
range of
800km

In 1964
it was the
world's highest
and longest-range
weather radar

9,000
people
worked on the
project




Student creativity shines

Mitsubishi Electric sponsored the 9th Japan Student BtoB Newspaper Advertising Awards, a competition that invites students to create advertisements centered on B2B companies for 2024. For this year's challenge, Mitsubishi Electric selected its low-voltage circuit breakers – a product with a legacy dating back to 1933 – as the focus.

The students were tasked with developing innovative advertising concepts and expressions for this classic product, offering fresh insights beyond those typically seen in industry. We're pleased to present the winning entries for the Jury's Special Award and the Mitsubishi Electric Sponsor's Award, along with their comments that eloquently capture the aspirations of design students for factory automation.

Winning concepts in Mitsubishi Electric's B2B advertising challenge



The Jury's Special Award

Ms. Akuri Komatsu:
Cut off overcurrent

I wanted to clearly and simply show the idea of a circuit breaker stopping an overcurrent and keeping electricity safe to use. As I brainstormed, the image of dominoes came to mind.

In a post-award interview, we asked the design students, "What do you expect from factory automation (FA) in the future?" Their responses, rooted in their own unique perspectives, were as inspiring as their award-winning entries.



Ms. Akuri Komatsu: "Certain processes will always be time-consuming and prone to errors when done by hand. The advantage of FA is that it allows products to be made with speed and precision. Like Ms. Sasaki, I believe FA is essential in many areas to achieve high-quality production. I hope to see this technology continue advancing."



Mitsubishi Electric Sponsor's Award

Ms. Izumi Sasaki: The current of love never stops!

I wanted to avoid people thinking, "This doesn't apply to me," and skipping over the ad. That's why I chose the theme of "love," which everyone can relate to.



Ms. Izumi Sasaki: "I'd like to see FA help preserve traditional manufacturing skills for future generations. For example, if we could quantify techniques that rely on the experience and intuition of skilled craftspeople, we could ensure these valuable skills aren't lost."

Their insightful comments – "FA plays a key role in preserving traditional manufacturing skills for future generations" and "There are many areas where FA is essential for producing high-quality goods" – revealed a profound understanding of FA's impact. We were genuinely impressed by how these design students, with no direct connection to factory automation, captured its significance and potential so succinctly.

We look forward to seeing the innovative contributions they'll make in the future.

Read the full interview here



<https://www.mitsubishielectric.co.jp/fa/the-art-of-manufacturing/column/expert-views37/index.html>

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