THE ART OF MANUFACTURING

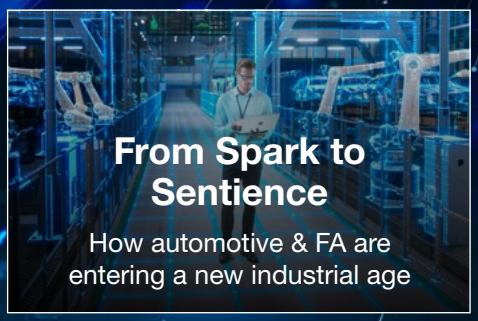
ものづくり monozukuri

MITSUBISHI ELECTRIC
Changes for the Better

ISSUE 8

Mitsubishi Electric Factory Automation Customer Magazine

DRIVING THE EVOLUTION



From Spark to Sentience

How automotive & FA are entering a new industrial age

Smart Factory Now

Toyota Motor East Japan & Renault Group

A Journey to Electric Vehicles

Motor Journalist talks about the future of car life

Future Mobility Demands Future Manufacturing – Are We Ready?

As the automobile approaches its 140th birthday, it's remarkable to think that Karl Benz patented his Benz Patent-Motorwagen back in 1886.

While Henry Ford's production revolution transformed the industry, it's arguable that for much of the 20th century, little fundamentally changed. But over the past 20 years, we've seen rapid developments: battery electric vehicles are now a reality, hydrogen-powered vehicles are emerging as a possibility, and even the concept of a person behind the steering wheel is being challenged as self-driving technology advances.

But what about manufacturing processes? Have they kept pace with these innovations?

Discover the current state of play in the automotive industry in the latest edition of The Art of Manufacturing - Monozukuri Magazine.

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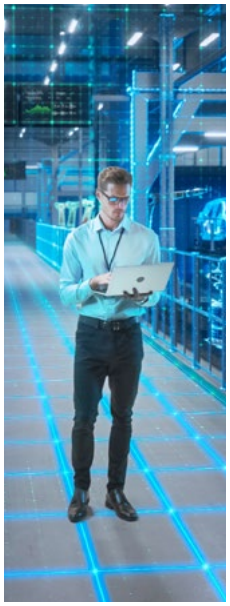

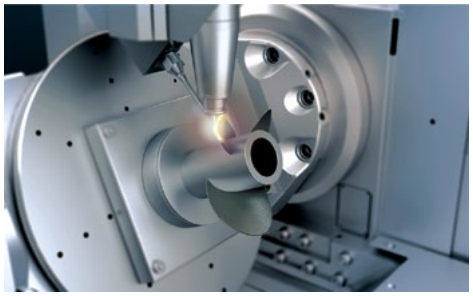

Researcher with World Impact

Dr. Stefano Di Cairano's Vision for Smarter Mobility

As the automotive industry accelerates towards electrification, automation, and intelligent mobility, researchers are shaping the control systems that make this future possible.

In January 2025, Dr. Di Cairano, Distinguished Research Scientist and Deputy Director at Mitsubishi Electric Research Laboratories (MERL) in Cambridge, Massachusetts, was named an IEEE Fellow, the organization's highest grade of membership, recognizing less than 0.1% of its 420,000 members annually. His elevation cites fundamental contributions to model predictive and constrained control in automotive and aerospace applications.

From developing algorithms that optimize highway merging for connected and automated vehicles to federated learning models that enable smart traffic prediction, Dr. Di Cairano's work bridges the physical and digital worlds of transportation.

His research addresses one of the industry's toughest challenges: how to safely and efficiently coordinate thousands of autonomous vehicles in real-time within complex urban environments.

As electric and autonomous vehicles reshape manufacturing processes, the underlying control technologies pioneered by researchers like Stefano Di Cairano will determine how efficiently, safely, and sustainably these innovations integrate into society. ■

About Dr. Stefano Di Cairano

- IEEE Fellow, Class of 2025
- Ph.D. Information Engineering, with focus on Control Systems
- Distinguished Research Scientist & Deputy Director, Mitsubishi Electric Research Laboratories
- Chair, IEEE CSS Technology Conferences Editorial Board, Vice Chair IFAC TC Optimal Control, Executive Member IFAC Industry Committee

www.merl.com/people/dicairano | Lean more about Mitsubishi Electric Research Laboratories (MERL): www.merl.com

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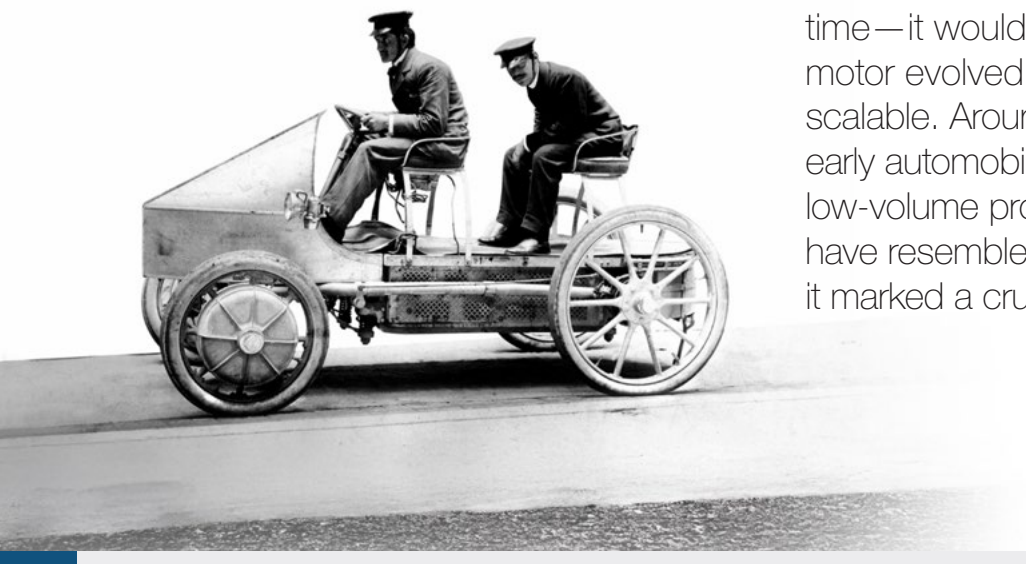
From spark to sentience

How automotive and automation are entering a new industrial age



In 1834, an early electric motor quietly signaled the beginning of an energy transformation. But commercialization took time—it would be nearly 50 years before the motor evolved into something useful and scalable. Around the same period, Carl Benz's early automobile designs began moving into low-volume production. And while it may not have resembled today's mass manufacturing, it marked a crucial pivot in personal mobility.

The Spiral of Innovation

1834: Electric motor || 1888: Early electric vehicle || 1913: Ford assembly line || 2000s: IoT & cloud in manufacturing || 2020s: Acceleration of EVs

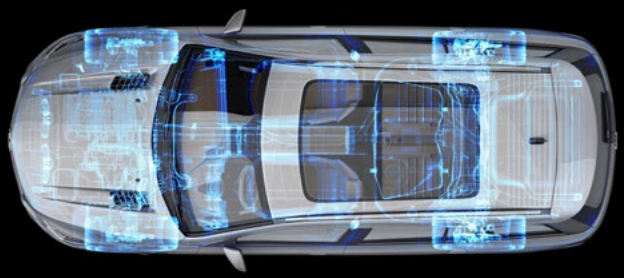
From the start, the automobile and its manufacturing methods have evolved in a spiral—each innovation in vehicle design driving new production technologies, and each advance in manufacturing unlocking new possibilities in mobility.

Fast-forward to the 21st century, and we're seeing the reemergence of the electric car in its second age—this time, layered with sensors, software, and AI.

Today, a modern vehicle is often called a "smartphone on wheels." High-end models may contain close to 1,000 ECUs (Electronic Control Units) and up to 3,000 semiconductors—controlling everything from in-cabin climate to ADAS braking systems. As the car evolved into a digital machine that continues to improve its performance even after being sold, the factory that builds it had to evolve too.

From Automation to Intelligence

Behind every high-tech vehicle is a manufacturing system undergoing its own transformation. The Fourth Industrial Revolution brought us cyber-physical systems, IoT sensors, and cloud-connected machinery. But now, the Fifth Industrial Revolution is beginning to emerge—defined by Agentic AI: intelligent systems that don't just analyze data but make decisions, configure themselves, and collaborate autonomously across networks.



In this new paradigm, AI doesn't just flag faults—it prevents them. Machines equipped with learning capabilities detect abnormal vibration patterns, thermal changes, or power fluctuations, and adjust their operation in real-time. They trigger service protocols automatically and adapt to avoid downtime. This is the shift from descriptive to prescriptive and self-organizing manufacturing.

The Edge of Insight

While cloud platforms have transformed enterprise visibility, many of the most valuable predictive insights are now being made directly on the factory floor.

Modern AI-driven platforms allow engineers and maintenance teams to perform sophisticated data analysis without needing programming expertise. Edge-level systems monitor servo drives, robots, and inverters—learning their behavior over time, identifying anomalies, and preventing faults before they impact production. These technologies also protect sensitive factory data by keeping it within the local network, ensuring security and real-time responsiveness. In some cases, the devices themselves have gained onboard AI capabilities—enabling them to diagnose issues independently. For example, robots can now predict joint wear, and servo systems can detect problems in connected mechanical components such as belts, gears, or ball screws—alerting operators in advance of serious failures.

As one automation expert put it: "We've taken capabilities that traditionally required data scientists and made them accessible to the people who know the machines best."

Complexity, Multiplied

The challenge is no longer just about preventing machine failures—it's about managing exponential complexity. Automotive manufacturers must now produce fossil fuel, hybrid, and electric vehicles, often with overlapping production lines. The ultimate goal? A single, adaptable line capable of handling all variants seamlessly. And regardless of the drivetrain, today's vehicles are increasingly electronic. That means more wiring, more software, and tighter integration across components.

Production systems must adapt in real-time—not just to changes in design, but to the way demand shifts across regions. This calls for a flexible, layered maintenance strategy: combining predictive, preventive, and corrective methods in a unified approach.

Looking Beyond the Factory Walls

As Mobility as a Service (MaaS) gains momentum, vehicle uptime becomes an economic imperative. Fleets of autonomous or electric vehicles must be monitored, feature updates automatically shared or enabled after purchase, vehicles maintained and repaired predictively—just like the factories that build them. The tools developed for smart production lines are now migrating downstream, enabling lifecycle management for the vehicles themselves.

And with global platforms scaling across dozens of sites, coordination becomes key. Solutions must work not only at the component level, but also across regions, languages, and infrastructure differences.

Intelligent Systems, Measurable Impact

Case studies are a great place to learn as they show what's possible, for example:

- Global manufacturers have implemented diagnostic systems that detect potential failures in robot joints weeks in advance—triggering service workflows automatically.
- Condition-based asset management programs span multiple countries, requiring only hours to deploy at each new site.
- Real-time SCADA systems help tire manufacturers like Continental AG reduce overhead, protect data, and streamline operations across 18 plants worldwide.

However, in each case intelligent automation isn't just a technical upgrade—it's a business continuity strategy.

What Comes Next

McKinsey has noted that industrial automation is approaching a tipping point, where maturity, affordability, and necessity converge. But what separates leaders from laggards is no longer just technology—it's the ability to scale intelligence across the entire value chain.

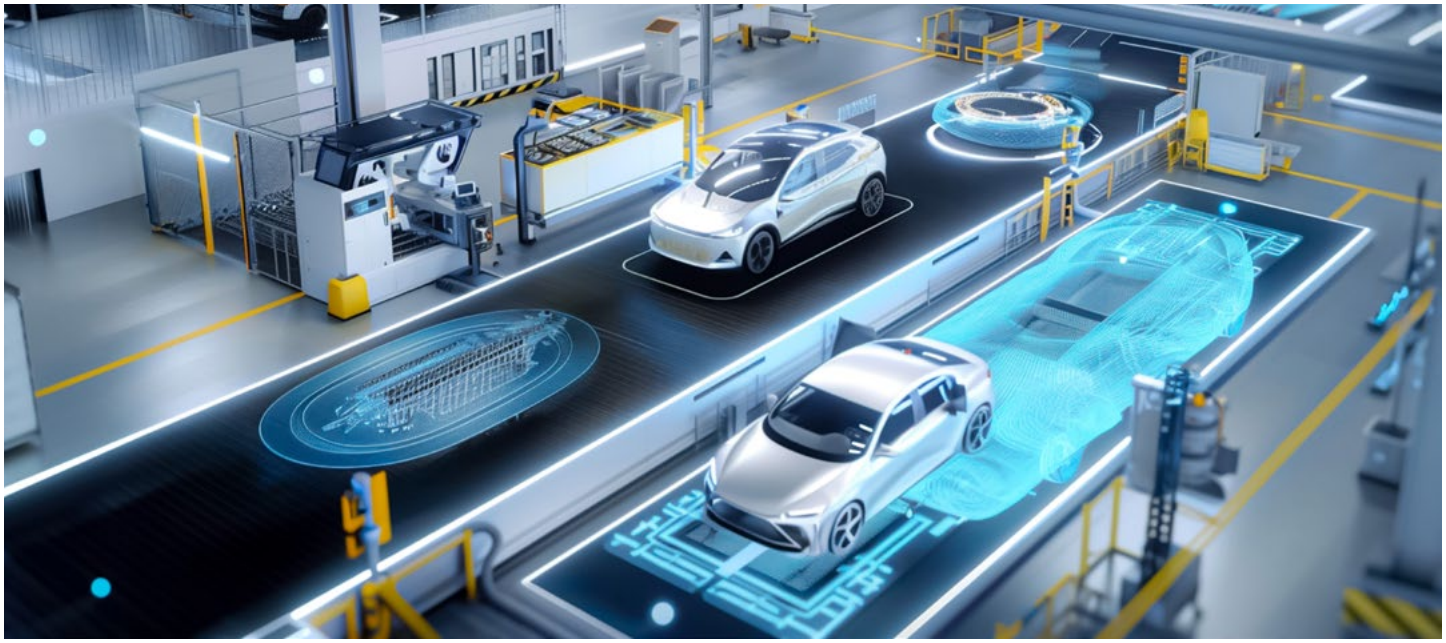
In modern automotive manufacturing, achieving carbon neutrality across the entire supply chain is essential requirements. The future factory won't just follow a program. It will follow intent. Self-organizing systems powered by Agentic AI will dynamically reconfigure operations in response to goals, constraints, and real-world feedback. That's the promise of the Fifth Industrial Revolution.

A New Kind of Readiness

Even as automotive manufacturers navigate the complexity of multi-drivetrain production and software-defined vehicles, many of the foundations for this transition have already been laid—quietly, steadily—over the past two decades of digital transformation.

The shift from physical to digital vehicle models has enabled virtual testing, faster iteration, and more efficient early-stage development. Co-design with suppliers using 3D CAD data has become standard, allowing engineering decisions to be made earlier and more collaboratively. Modular and platform-based vehicle architectures have emerged in response to rising model diversity, helping balance product differentiation with production efficiency.

Meanwhile, traceability technologies—from advanced barcode tracking to digital twins—are helping manufacturers ensure quality and compliance across increasingly complex assemblies. These same systems are now being extended to support zero-emission manufacturing goals, where every gram of material and kilowatt-hour of energy is monitored and optimized.



But as the industry pivots to EVs, new layers of challenge appear: battery supply chains, thermal systems, power electronics, and vehicle safety standards all require new manufacturing expertise. Workforce training must evolve in parallel, preparing teams to handle high-voltage systems and sensor-heavy platforms. Production lines must flex to accommodate variations in range, charging, and region-specific regulatory features—all while keeping costs competitive.

In this environment, intelligent systems become more than just enablers of efficiency—they are strategic assets. They help manage complexity, enable faster decision-making, and ensure continuity across a globally distributed network. Most importantly, they provide manufacturers with the readiness to adapt—not just to electrification, but to whatever comes next. ■

Physical to Digital Shift
Virtual testing / CAD co-design / faster iteration

Modular Platform Architecture
Flexibility across vehicle variants

Traceability Technologies
Barcode tracking / digital twins / compliance assurance}

Sustainability Layer
Emissions monitoring / material & energy optimization

Expert voices

Our expert report and white papers explore these transformations in depth—detailing the technologies, strategies, and results achieved by some of the world's leading automotive manufacturers. For those charting their own course through electrification, automation, and intelligence, the path forward begins with insight. Download the full expert report and white paper to dive deeper into the future of automotive manufacturing.

https://www.mitsubishielectric.com/fa/solutions/industries/automotive/driving-the-evolution/expert-report-2025/index.html

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A Journey to Electric Vehicles

Motor Journalist / Forbes Columnist Peter Lyon talks about the future of car life.

I've spent many years driving all kinds of cars around the world. Surrounded by the smell of gasoline, thrilled by the sound of an engine, I've always enjoyed driving. So now that we're entering an era where EVs are becoming more popular, to be honest, I have a lot of mixed feelings.

First, let me be clear so there's no misunderstanding: I don't think EVs are bad. If more vehicles support rapid charging and charging spots become more widespread, I actually believe they're usable on a daily basis. Plus EVs will get more popular as range improves too. They're quiet, have sharp acceleration, and smart control systems. Especially in urban driving, there's probably nothing more comfortable. Imagine taking your pet on a drive to the beach—EVs make that easier. Dogs and cats are sensitive to noise and vibration, so the absence of engine noise really changes the atmosphere in the cabin.

But you see, I tend to look at EVs from the perspective of whether you can love them as cars. That's because, to me, a car is not just a means of transportation—it's something you experience with your senses. The sound of the engine, the ride quality, the sense of unity you get through manual operation, and above all, great design—those are what have always made a car something I could truly love. And in today's EVs, that part still feels lacking.

Modern EVs all drive smoothly, efficiently, and quietly. But that alone isn't enough. It's like a delicious meal that has no aroma or character—it fills your stomach, but doesn't excite your heart or stomach. If I were to wholeheartedly recommend an EV to someone, it would only be if I was convinced their sensibilities would truly resonate with it.

In other words, to enjoy EVs, we humans need to update our own sensibilities. For people who can shift their perception—from the "sound," "vibration," and "smell" that defined cars before, to "smooth acceleration," "silent comfort," and "software-driven personality"—EVs already offer plenty of appeal.

Recently, we've seen EVs that generate simulated engine sounds or create vibrations during driving. I find these kinds of efforts fascinating. It's great to see attempts to help us "gasoline-generation" drivers feel the appeal of EVs. If OTA[1] updates eventually allow fully personalized driving experiences, it might bring us even closer.

That said, I still haven't encountered an EV that sparks my heart except maybe an Audi RS e-tron GT. For example, the Jaguar XJ8—a car I'm truly infatuated with—felt like it was made entirely of pure emotion. If a car like that appeared in the EV world, I wouldn't hesitate to buy it.

Now, there's another important topic: the relationship between young people and cars.

People often talk about "young people losing interest in cars," but I don't quite agree. It's not that they've moved away from cars—it's how they relate to them that has changed. When I was young, not owning a car meant you weren't cool—you weren't a real man. Especially when dating, you'd pick a lady up, go to a nice restaurant, catch a movie—that was the way you dated. But now, the way people relate to cars keeps evolving. Even today's young people customize KEI VAN[2] (microvans) to go camping, restore classic cars and share them on social media. Whether it's ITASHA[3] culture or DIY projects, they're connecting with cars in their own ways.

For today's younger generation, cars are tools for self-expression. And at the same time, they're a medium for connecting with others. Self-expression and empathy—those are the key words.

For example, KEI VANs or old manual-transmission cars—part of the fun is the effort they require to actually drive the car. On the other hand, EVs with smartphone integration and app-based tuning fit the generation that wants to express their individuality through software. Either way, both are ways of playing with cars.

Still, there's the barrier of cost at the purchase point. If used cars, or car sharing became a little more accessible, more young people could take that first step. Some policy support will be necessary, too.

Finally, here's what I believe:

The future of EVs lies in flexibility and diversity.

Back when we transitioned from steam to internal combustion, it wasn't just the technology that changed—society and people's lifestyles were transformed, too. And now, once again, we stand in a similar moment of transition.

From here on, car culture won't be about performance competitions, it will be about how people build relationships with their cars. For EVs to become cars you can truly love, they'll need to evolve in a way that embraces sensitivity and technology—especially viable long-lasting, quick-charging battery technology, playfulness and social value of it together, and of course focus more on inspired design.

Yes—even among EVs, some desirable reasonably-priced EVs are starting to appear.

I believe that the trend will only continue to improve. ■

> "In the electric age, cars you can fall in love with are starting to appear."

Born in Australia in 1960. Became a motor journalist in 1988. Known as "the only foreign journalist who can write articles in Japanese," he contributes not only to Japanese media but also to major international outlets such as Forbes, Car and Driver (USA), Auto Express (UK), and Quattroruote (Italy).In 2014, he published "Thank You Hazard: The International Language of Road Manners," (Thank You Hazard: Sekai-no-ai-Kotoba) which explored Japan's "Samurai Wheels," introducing Japan's car culture in automotive culture through the lens of a foreigner.

Since spring 2015, he has been the presenter of the NHK World TV series English to 160 countries together with ex-F1 racer Ukyo Katayama. He is ex-chair of the World Car Awards, a juror for the Japan Car of the Year awards, and a judge for the Best Cars of the Year awards. Lyon created a race team in 2010 and co-drove with 3 other drivers in the Nurburgring 24-hour race in Germany, placing 4th in class.

Peter Lyon
Motor Journalist

[1] OTA (Over-the-Air) technology: A wireless data transmission method.

[2] KEI VAN: It is a type of vehicle in Japan.

[3] ITASHA: Vehicles decorated with Japanese "Anime".

Navigating an Uncertain Future

Intelligent Solutions that Support the Automotive Industry

Over the past 25 years, automakers around the world have faced the dual pressure of meeting increasingly strict emissions and fuel efficiency regulations while also reducing development costs and shortening production timelines. For automotive manufacturers, this has required a delicate balance of innovation, quality control, and strategic investment.

EV Growth and the Widening Global Divide – Manufacturing in Uncertain Times

As highlighted in the IEA's latest report, global electric vehicle (EV) sales in 2023 are set to exceed 17 million units, with 64% sold in China, 18% in Europe, and 8% in the United States. Since 2020, the global penetration rate of EVs (including BEVs and PHEVs) has risen steadily each year. 2023 marks the fifth consecutive year of strong growth, with a 22% increase from the previous year. (Source: IEA).

With electrification targets set for 2030 and 2035, and fuel economy standards under review, automakers face growing pressure to accelerate development cycles like never before. Yet as one executive at a major automaker noted, "We can't predict what the market will look like ten years from now. Focusing too heavily on EVs carries significant risks."

There are two key reasons for this caution. First, reduced subsidies and rising costs—driven by tariffs and other factors—may slow growth in some regions. Second, the mix of EVs, PHEVs, HEVs, and MHEVs varies widely across markets, requiring region-specific strategies. The contrast is clear even within Asia, where trends in China and Japan diverge significantly.

To stay profitable, manufacturers must meet diverse regional needs while producing multiple powertrain types—EVs, HEVs, and ICE vehicles. This demands fast, flexible, and highly efficient manufacturing systems. For the industry, the time to act is now. ■

What makes automotive development especially demanding is a unique combination of factors not seen in many other industries:

1 Vehicles are high-cost products.

2 They serve a wide and diverse customer base, across income levels, age groups, and global markets.

3 They must perform reliably in a vast range of environments, from extreme heat to freezing temperatures.

4 They are tightly linked to public infrastructure and must comply with evolving safety and environmental regulations.

5 Development requires massive financial investment.

6 The development cycle is significantly longer than that of typical industrial products.

The automotive industry is at a turning point. Automakers are gearing up for the rise of electric (EVs) and software-defined vehicles (SDVs) by 2030, requiring faster, more adaptive, and cost-efficient development. Yet uncertainty remains, as EV adoption differs across markets. Manufacturers must still produce ICEs, PHEVs, and BEVs—adding complexity to production.

To stay competitive, they need flexible systems that can adapt to varied vehicle types and volumes while improving efficiency. This feature explores advanced components and intelligent manufacturing solutions to help automakers meet regulatory and production challenges and prepare for the future of mobility. ■

From Pressure to Progress

The automotive industry's pressing challenges and the solutions that address them:

Shorter development cycles, flexible line changes.

- Digital Twins
- Data Science
- AI-powered skill and know-how transfer

Boosting productivity and efficiency

- Predictive Maintenance
- AI-Driven Inspection
- High-efficiency Drives

Readying for EV-Specific needs and workforce change

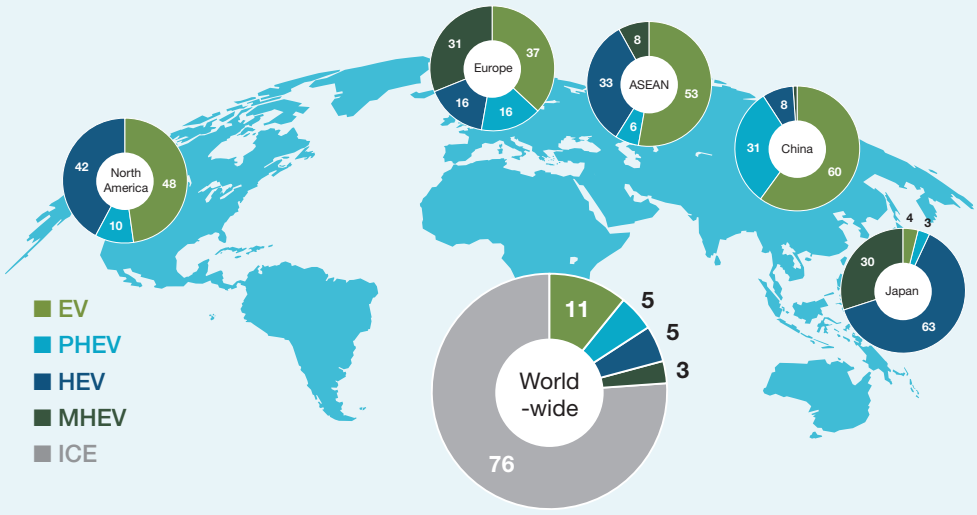
- 3D Metal Printing
- Collaborative Robots
- Workforce Development

Achieving Carbon Neutrality in the Supply Chain

- Real-time Energy Optimization
- Sustainable Manufacturing
- Energy as a Manufacturing KPI

Protecting the Connected Factory

- Industrial Cyber Security Standard IEC 62443



2023 Electric Powertrain Composition by Region

This chart shows the breakdown of electric vehicles (EVs), plug-in hybrid vehicles (PHEVs), hybrid vehicles (HEVs), and mild hybrid vehicles (MHEVs) among electrified vehicle types. Fuel cell vehicles (FCVs) are excluded due to low volumes, and MHEVs are omitted in North America due to lack of data. Only the global market graph includes all five vehicle types, including Internal Combustion Engine vehicles.

(Source: MarkLines market research data)

Challenges: Shorter Development Cycles, Flexible Line Changes

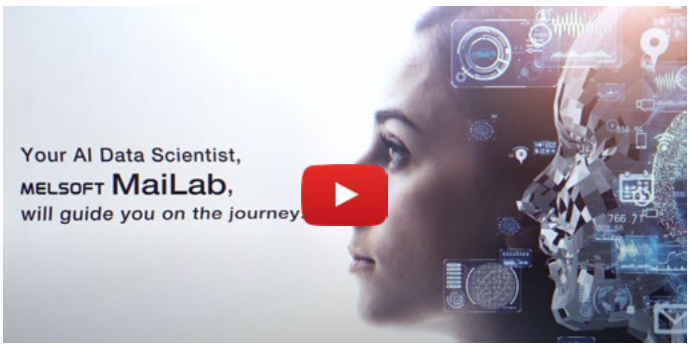
Cutting Time-to-Market with Digital Twins and Intelligent Components

In today's manufacturing landscape, speed matters. Precision does too. Nowhere is this more evident than in the automotive sector, where companies are rethinking how they design, build, and deploy production systems.

Shorter product cycles, supply chain disruptions, and demand for greater model variety are putting production teams under pressure to deliver faster and smarter. These challenges extend beyond prototyping. They reach deep into the factory itself, where lines must be commissioned quickly, adapted on the fly, and maintained with minimal disruption.

In response, manufacturers are turning to digital twins and AI-enhanced automation as practical tools for improving speed, accuracy, and adaptability on the shop floor.

Predictive maintenance helps engineers anticipate issues before they arise, boosting uptime and efficiency.



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

Simulating the Line Before It's Built

Digital twins—virtual models of machines, systems, or entire production lines—are now being used to simulate processes before a single bolt is tightened. Mitsubishi Electric's MELSOFT Gemini is one such tool, enabling engineers to model layouts, visualise workflows, and test process logic in 3D. This is proving especially valuable in sectors like EV battery and drivetrain manufacturing, where design flexibility is critical.

In one example, a manufacturer used Gemini to simulate the addition of a workstation and operator on an existing line. The result? A 10% reduction in cycle time and measurable cost savings—achieved without interrupting live production or physically trialling changes. These virtual assessments are fast becoming a key step in system design, allowing teams to explore "what if" scenarios, validate performance assumptions, and identify bottlenecks—before delays hit the shop floor.

Smoother Commissioning and Fewer Surprises

Getting a new production line from design to operation can be a challenge. Delays caused by logic errors, unexpected behaviour, or control misconfigurations can easily stall progress. That's where simulation tools like MELSOFT Mirror come in. Rather than waiting for hardware to be installed, teams can test and debug control logic in a virtual environment.

This approach removes much of the guesswork from commissioning. It's especially valuable in complex settings, where subassemblies, rapid model changes, and tight tolerances leave little margin for error. According to Mitsubishi Electric, combining Gemini and Mirror has helped some manufacturers cut development and commissioning time by up to 30%.

From Experience to Prediction

The final piece in this puzzle is how data is being used to capture and apply human expertise. As senior engineers retire or move on, interest is growing in tools that replicate operational know-how. One example is MELSOFT MaiLab, which uses AI to analyse data for early signs of abnormalities.

Applications include spotting wear patterns and predicting maintenance needs. For operations with expensive tooling or narrow process windows, AI-enhanced predictive maintenance can prevent downtime and protect quality.

Getting Ahead and Staying Ahead

Digital transformation in manufacturing is often framed in abstract terms. But in the automotive sector, it's becoming a practical reality. From simulated line design to condition-based maintenance, digital tools are now shaping how factories run and evolve. And while no single solution guarantees success, those embracing these technologies are better equipped to meet demand, pivot faster, and maintain output—even under mounting pressure. ■

Expert voices

Albert Ganz, General Manager of Sales and Quality, emphasizes the importance of flexibility: "OEMs are increasingly creating digital models and simulating manufacturing environments in parallel with actual implementations. This approach saves time and money while enhancing adaptability. While most manufacturers now design for multiple scenarios, they still need flexible automation strategies that respond quickly to changing market conditions, without costly line overhauls."

Albert Ganz
General Manager of Sales and Quality

https://www.mitsubishielectric.com/fa/solutions/industries/automotive/driving-the-evolution/expert-report-2025/index.html

Maximising Efficiency with AI-Driven Maintenance and Inspection

Addressing complexity is now central to modern manufacturing strategy. As competition intensifies and supply chains grow more dynamic, manufacturers face increasing pressure to improve efficiency and precision. Artificial intelligence is playing a growing role in this shift. From predictive maintenance to automated inspection and smarter energy management, AI-driven technologies are moving from experimental to essential.

Yet adoption varies. Some manufacturers have embedded AI into key production systems, while others encounter roadblocks ranging from integration complexity to skills shortages. Across the sector, a consensus is forming: future competitiveness will be built on data-driven insight, autonomous optimization, and energy-efficient control.

Fixing It Before It Breaks

For years, maintenance in manufacturing was reactive. A machine broke down, technicians were called, and production halted. AI is now turning that equation on its head.

One key element is as shift towards intelligent devices and systems. For example, the servo system, MELSERVO-J5 Series, incorporates real-time monitoring, analytics, and machine learning to detect potential signs of abnormality in connected mechanical systems such as ball screws, belts, and gears. By continuously assessing environmental and performance data, these servos alert operators before failures occur, allowing for planned interventions rather than costly breakdowns.

Challenges: Boosting Productivity and Efficiency

In parallel, software tools are also helping advance fault diagnosis. In the case of System Recorder IC software, it acts like an industrial "black box", capturing a running log of machine activity that can be replayed after faults, drastically reducing troubleshooting time and speeding up recovery.

Cutting Errors Not Corners

Another area where AI is making a measurable impact is quality control. Visual inspection, once reliant on human operators and prone to inconsistency, is being transformed by smart vision systems.

Solutions like MELSOFT VIXIO combine AI algorithms with high-resolution 3D cameras to spot defects quickly and consistently. Whether detecting microcracks in battery housings or alignment issues in drivetrains, these systems reduce the likelihood of errors slipping through. They also cut reliance on human inspectors, which is helpful in a labour market where experience is in short supply.

For manufacturers automating their inspection lines further, integrating industrial robots with advanced sensors and vision inspection systems can support seamless inline inspection without additional programming complexity. The goal is not just to replace people but to relieve them from repetitive, error-prone tasks so they can focus on process optimisation and exception handling.

More Than a Trend

While some manufacturers still view AI as an emerging technology, the direction of travel is clear. Predictive maintenance and intelligent inspection are already reshaping how production lines are run and maintained.

These technologies are not just upgrades, they are enablers. For businesses aiming to compete in high-pressure manufacturing markets, investing in AI-driven systems may be the difference between being first to market or being left behind. ■

Expert voices

Stephen Methogo, Director EV & Lithium-Ion Battery Industries EMEA at Mitsubishi Electric, reports: "Our implementations at European automotive plants show the power of this approach: 65% less manual inspection time, 40% fewer welding defects, and payback within 4.5 months.

https://www.mitsubishielectric.com/fa/solutions/industries/automotive/driving-the-evolution/expert-report-2025/index.html

Stephen Methogo
Director EV & Lithium-Ion Battery Industries EMEA

Smart Factory Now!

Case Study: Toyota Motor East Japan

Toyota Optimizes Logistics Processes with 3D Simulation

Toyota Motor East Japan, based in the Tohoku region, handles everything from planning to production of compact cars, including the Yaris, Aqua, Sienta, and LBX. To improve safety, quality, and productivity, the company has long focused on optimising factory layouts and logistics—but struggled to find suitable tools. "It was not easy," recalls Mr. Kohei Hanzawa.

The turning point came with the introduction of Mitsubishi Electric's 3D simulation software, MELSOFT Gemini, which creates virtual models of production lines and warehouses, allowing layout and timing simulations that help shorten development periods.

https://www.youtube.com/watch?v=YT15puTlK6g

The team first applied Gemini to the logistics warehouse. Using the software's built-in components, they easily created 3D models and simulated inventory movement and transport routes. This gave them a clearer overall view than 2D drawings could provide. "By visualising the entire logistics flow, we can now identify problems faster and consider improvements," says Mr. Seiichi Kamio. Previously hard-to-detect issues like forklift route conflicts became obvious. "Thanks to Gemini, we can understand issues and make objective improvements" adds Yuto Totsuka.

"3D reviews are already becoming the norm. We want to establish this approach and deliver attractive compact cars from Tohoku to our customers more quickly," Mr. Hanzawa adds.

Case Study: Renault Group

Accelerating the EV era with a Smarter Factory

At Renault's Cleon plant in Normandy, France, electric motors and hybrid engine components are produced with high precision. In a 2017 production line upgrade project, Mitsubishi Electric's factory automation (FA) technologies played a central role, bringing advanced Japanese manufacturing capabilities to the site.

"From the early stages of operation, the line exceeded our expectations. Increased automation and digitalization transformed the plant into a smarter factory," says Jérôme Eline, EV projects director, Renault group.

The production line integrates PLCs, HMIs, motion control devices, and software solutions that bridge the shop floor and IT systems.

https://youtu.be/MYN47NfvMzQ

This enabled real-time visibility and traceability, with all equipment connected via secure OPC UA communication to higher-level IT infrastructure—now standard practice at Renault facilities.

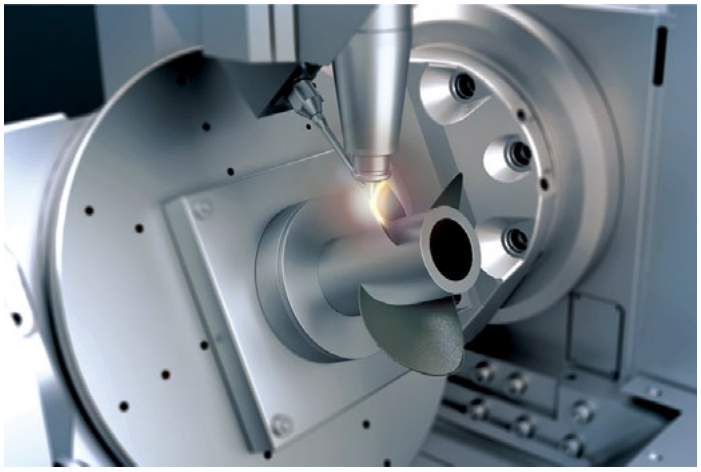
Mitsubishi Electric's engineers were involved from the development phase, helping ensure a smooth ramp-up to full-scale operation. "Mitsubishi Electric has always been present during the start-up phase of the line.", Cyril Fournol, EV project manager, Renaut group.

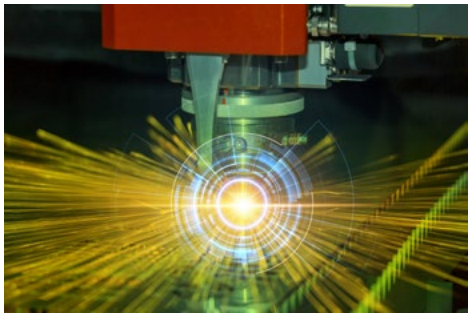
As Renault addresses the key industry challenges of electrification, digitalization, and decarbonization, it also prioritizes reducing the environmental footprint of its production. Minimizing CO_2 emissions from the factory floor is now seen as an essential part of the company's overall commitment to sustainability efforts.

Driving the EVolution with New Materials and Skills

Challenges: Readying for EV-Specific needs and workforce change

Electric vehicles are reshaping not just mobility, but manufacturing itself. As range and efficiency become top priorities, one factor stands out: weight reduction. Cutting unnecessary kilos improves energy performance, making lightweight design a core competitive edge.





Additive Manufacturing (AM), a process that creates three-dimensional structures by building them layer by layer, enables optimized designs and makes it possible to reduce the weight of components while maintaining their strength.

This shift requires more than new materials – it demands rethinking how factories operate and how people work. High-strength metals and carbon fibre reinforced plastics (CFRP) are enabling lighter, stronger vehicles, but they're also harder to process. That's where new technologies step in.

Smarter Tools for Lighter Components

Processing CFRP at scale has been a major hurdle – one Mitsubishi Electric has addressed with its CV Series of CO_2 laser processing machines. Recognised with a Good Design Award, the CV Series enables precise, efficient cutting of parts like battery trays and aerodynamic panels, helping manufacturers integrate lightweight components at production speed.

AI Takes Over the Fine-Tuning

The move to advanced materials also changes how decisions are made on the shop floor. AI now plays a central role in optimising toolpaths, adjusting laser settings, and maintaining quality in real time. Whether in machining or additive manufacturing, these insights translate to better output with less waste – crucial for scaling EV production affordably.

The Road Ahead

The evolution of EV manufacturing is not defined by a single technology. It is a convergence of material science, automation and workforce strategy. To reduce weight without sacrificing strength, manufacturers are embracing new materials like CFRP and metal alloys that require different thinking at every stage of production.

As the sector continues to evolve, manufacturers must think beyond short-term gains. Future-proofing operations, through smarter technologies, more agile production systems and a skilled, adaptable workforce will be key to staying competitive. The factories building tomorrow's electric vehicles won't just look different. They will operate differently, think differently and demand different leadership. That transformation is already in motion. ■

Carbon Neutral Manufacturing: From Footprint to Future

Challenges: Achieving Carbon Neutrality in the Supply Chain

Manufacturing is under growing pressure to decarbonize. Factories remain among the highest energy consumers globally and their transition to cleaner, more efficient operations is essential to achieving broader climate goals. Yet for many, the shift to carbon neutrality raises practical questions, not just about ambition, but about implementation.

Mitsubishi Electric has approached this challenge with clarity and commitment. Its Environmental Sustainability Vision 2050 outlines a long-term pledge to achieve net-zero CO_2 emissions across the full value chain, including manufacturing sites, supply chains, and the products themselves. Unlike many top-down declarations, the company has backed its targets with engineering action, ensuring sustainability is not only a corporate goal but a built-in product capability.

The Factory Automation (FA) division plays a key role in delivering this vision. Its technologies help manufacturers reduce emissions directly on the factory floor. Through energy-efficient components, advanced control systems, and data-driven optimisation, the FA portfolio provides a practical route to lower-carbon operations that can be measured and scaled.

A central part of this strategy is the EcoAdviser software, which gives manufacturers real-time visibility into energy consumption across their facilities. With granular data at their fingertips, operators can identify inefficiencies and take targeted action—such as upgrading equipment, adjusting workflows, or improving how energy loads are distributed.

This combination of strategic vision and practical tools reflects Mitsubishi Electric's broader philosophy. Sustainability is treated not as an add-on but as an integral part of manufacturing improvement. It also speaks to a wider shift in the sector, where environmental performance is now a core indicator of resilience and long-term value.

One tire producer, for example, is working on energy conservation initiatives with an initial goal of reducing its greenhouse gas emissions by 28% compared to 2019 levels by 2030. Longer term, it plans to achieve net-zero CO_2 emissions (carbon neutrality) by 2050.

With growing scrutiny from regulators, investors, and supply chain partners, the move toward carbon-neutral manufacturing is becoming a competitive necessity. Mitsubishi Electric supports manufacturers in making that transition by providing both the roadmap and the tools to make it real. ■

Learn more about Mitsubishi Electric Sustainable Manufacturing Initiative.

https://www.mitsubishielectric.com/fa/solutions/competencies/sustainability/index.html

Building Cyber Resilience in an Era of Connected Manufacturing

Challenges: Protecting the Connected Factory

As the automotive industry's added value shifts from hardware to software—driven by data integration through connectivity and the provision of mobility services using acquired data—the importance of cybersecurity is growing rapidly.

In today's "connected factories," which have become the new manufacturing norm, international standards for information and control systems are being released one after another to protect factories from cyberattacks that exploit vulnerabilities in equipment and networks. Mitsubishi Electric, with its advanced communication and security technologies, offers cybersecurity solutions tailored to the needs of the manufacturing industry.

Mitsubishi Electric's Cybersecurity Initiatives

Mitsubishi Electric plays a vital role in supporting broad and essential social infrastructure – from space systems to control systems. Since 2019, the company has established the Mitsubishi Electric PSIRT (Product Security Incident Response Team) as an internal framework to ensure the information security quality of its products and services, reinforcing company-wide efforts to address cybersecurity across all offerings. Building on this foundation, security is being integrated at every stage of the process –from Mitsubishi Electric's Nagoya Works and Industrial Mechatronics Systems Works acquiring IEC 62443-4-1 certification, to the design of new products such as the recently released MX Controller, which complies with IEC 62443-4-2, and to the integrity features of the CC-Link IE TSN network, which supports IDS/IPS, bandwidth control and authentication. ■

Expert voice

Frederik Kok
Senior Cyber Security Expert at
Mitsubishi Electric Europe B.V., Germany

With over two decades of experience, he specializes in strengthening the cybersecurity posture of industrial automation control systems. At Mitsubishi Electric, he helps organizations enhance cybersecurity. His expertise strengthens cyber resilience, protecting industrial operations from emerging threats.

https://www.mitsubishielectric.com/fa/solutions/industries/automotive/driving-the-evolution/

Mitsubishi Electric Toolbox

Smart Technologies for the EV Manufacturing Revolution

Electric vehicle production is transforming industrial manufacturing—demanding more than automation alone. Mitsubishi Electric's smart technologies offer the speed, flexibility and innovation EV makers need. In this issue's Toolbox, we explore four standout solutions powering the shift.

MELSEC MX Controller - Integrated Automation Controller

Synchronised for Speed and Scalability

Keeping high-speed, multi-process lines running smoothly, the evolution of control systems is essential. Mitsubishi Electric's MELSEC MX controller serves as the brain of next-generation manufacturing line. It delivers tight synchronized control across multiple axes, high-speed processing, and seamless integration into broader systems via the CC-Link IE TSN network with robust security functions.

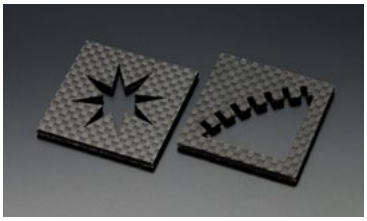
Its modular architecture gives engineers the freedom to scale or reconfigure lines without major disruption—critical when production must flex to support new drivetrains or models. The controller's precision and reliability are also ideal for complex operations like automated welding, laser machining or high-speed assembly. LEARN MORE

CV Series 3D CO_2 Laser Processing Systems

CFRP Processing Hits Mass Production

As EVs evolve, demand for lighter vehicle bodies to extend driving range is growing. CFRP (carbon fiber reinforced plastic), known for its light weight and high strength, is gaining attention, though its difficult-to-cut and shape properties have challenged mass production. Mitsubishi Electric has developed a new processing system featuring the world's first three-axis orthogonal CO_2 laser oscillator with a unique integrated structure.

This enables ultra-fast, high-precision CFRP processing, achieving cutting speeds up to six times faster than conventional methods. A specially designed single-pass processing head minimizes heat impact, enabling high-quality 3D shaping while reducing tool wear and waste. LEARN MORE



High-speed, high-quality machining of CFRP components.

AZ600 Wire-Laser Metal 3D Printer

Additive for Automotive Scale

While additive manufacturing has traditionally been used for prototyping, the AZ600 signals a shift toward real-world production. Combining laser control with arc-based wire deposition, this metal 3D printer can produce large, structural parts quickly and accurately. It's ideal for automotive components that need to be both lightweight and strong—like motor housings, battery modules, or support frames.

Using wire feedstock instead of powder makes the process safer and more cost-effective. Integrated with Mitsubishi's CNC technology, the AZ600 offers precise control over geometry and material use. For manufacturers aiming to reduce lead times, minimise waste, or produce complex parts in-house, it unlocks new possibilities. LEARN MORE

Capable of producing complex geometries such as mesh and periodic lattice structures.

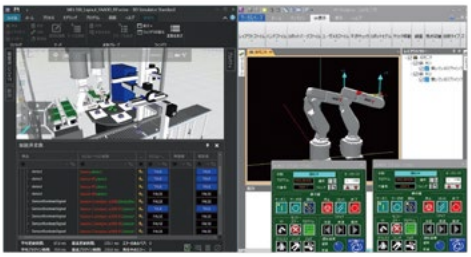
MELSOFT Gemini 3D Simulator

Simulating the Future of EV Production

In an industry moving this fast, trial and error is expensive. That's where MELSOFT Gemini comes in. As a 3D digital twin platform, it allows manufacturers to build and test entire production lines virtually—before any physical infrastructure is installed.

Engineers can simulate everything from robot movement to conveyor speeds, validate logic and refine layouts in real time. It mirrors Mitsubishi Electric's hardware platforms, meaning what works in Gemini will work on the line.

This is especially valuable when production needs to scale quickly or switch between vehicle platforms. Adjustments that once took weeks on-site can now be made in the digital world—saving time, cost, and disruption. Gemini also enables cross-team collaboration, giving design, operations and IT teams a shared space to troubleshoot and innovate together. LEARN MORE



Engineers can simulate everything from robot movement to conveyor speeds.

Automating the World of automotive manufacturing

Mitsubishi Electric has driven innovation across the automotive parts sector. From precision engineering to smart manufacturing, enhancing quality, accelerating productivity, and paving the way for a more sustainable, future-ready industry.

I-PEX

Operation: Japan

Business: Dies used for prototyping and mass production of electronic components and automotive parts

Automation used: Die sinking EDM, Remote maintenance services

Click here for the full story >

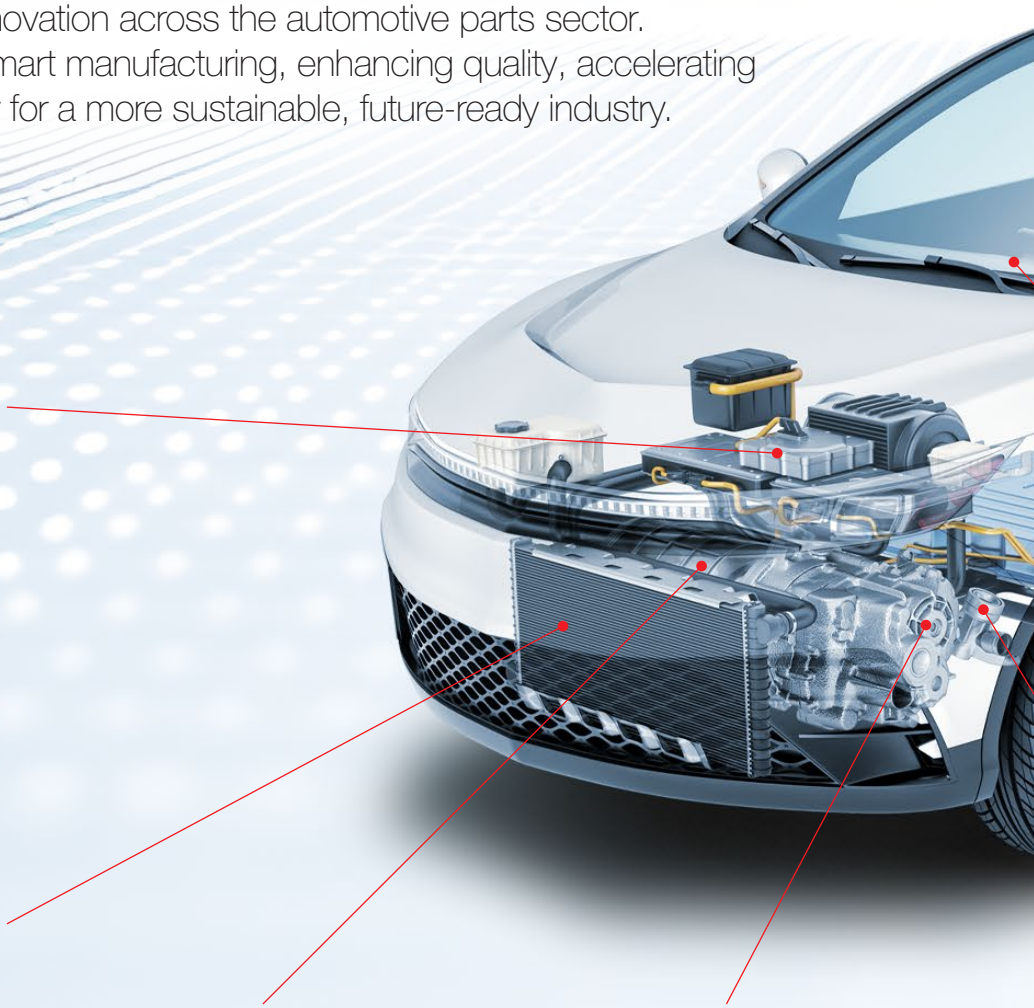
Rane Madras

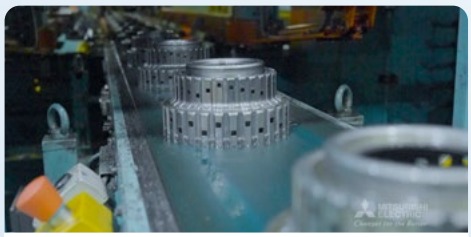
Operation: India

Business: Major OEM of car parts

Automation used: Inverters

Click here for the full story >





FCC (Adams)

Operation: USA

Business: Creates automatic transmission clutch assemblies and components

Automation used: IPCs, PLCs, MES, Networking

Click here for the full story >

Renault Group

Operation: France

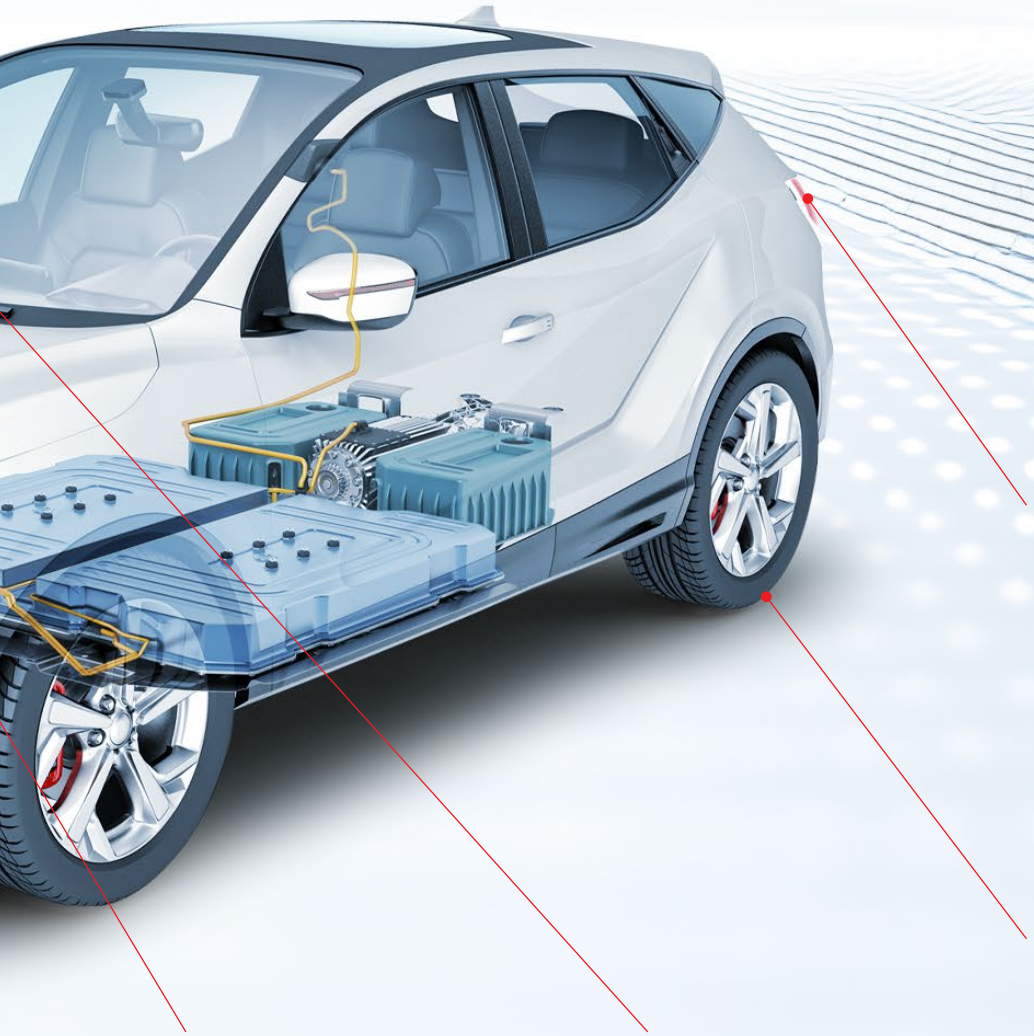
Business: Production of electric motors and components for hybrid engines

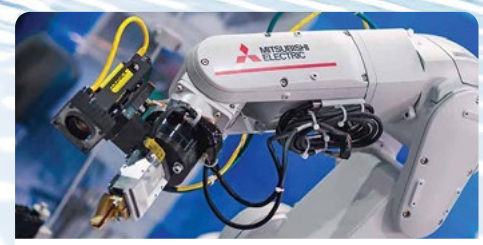
Automation used: PLCs, HMIs, Servos, Software solutions, Networks

Click here for the full story >

> The most impactful factory automation innovations were not necessarily new technologies but applying existing factory automation solutions, such as motion, AI, and vision, to innovative processes.

Giuseppe Polimeni
Global Strategic Account Manager within Automotive & EV sectors





Hella

Operation: USA

Business: Manufactures car electronics such as headlights, steering unit etc

Automation used: Robots, PLCs

Click here for the full story >

The Yokohama Rubber

Operation: Japan

Business: Manufactures and sells automotive tires and other products

Automation used: AI energy management tools, Energy monitoring units, PLCs

Click here for the full story >

Martinshof Werkstatt Bremen

Operation: Germany

Business: Produces sub-assembles such as steering, entertainment systems, reversing cameras etc.

Automation used: IPCs, PLCs, MES, Networking

Click here for the full story >

Battenberg

Operation: USA

Business: Haptic testing

Automation used: Robots, Scada

Click here for the full story >

News from around the world

US

New Immersive Showroom Opens

Innovation Hub

Mitsubishi Electric Automation has opened a new immersive showroom showcasing its full range of automation solutions, from legacy equipment to advanced AI diagnostics and 3D simulations. The space highlights products like automated production cells and interactive industry displays. The project took over two years of planning and seven months of construction. At the opening ceremony, leaders emphasized the company's commitment to quality, performance, and customer collaboration. The showroom helps visitors explore innovations supporting sustainable manufacturing and visualize improvements for their operations.

THAILAND

Mitsubishi Electric and METRON Partner for Decarbonization

Business Expansion

Mitsubishi Electric Factory Automation Thailand has signed an MoU with METRON to advance industrial decarbonization in Southeast Asia. The partnership will combine Mitsubishi Electric's industrial expertise with METRON's energy optimization technology. Together, they will ensure interoperability between platforms for secure data exchange and pursue joint business opportunities. This collaboration aims to help manufacturers lower their carbon footprint and improve performance. Mitsubishi Electric thanked METRON for their shared commitment to accelerating the energy transition in the region.

INDIA

Mitsubishi Electric to Invest in Indian No-Code Software Startup

Investment

Mitsubishi Electric India will invest in Gervigreind Data Science Pvt. Ltd. (doing business as "Itanta Analytics"), an Indian startup specializing in no-code data analysis tools for manufacturing. The collaboration will integrate Itanta's applications with Mitsubishi Electric's factory automation (FA) equipment and SCADA software to offer cost- and time-efficient digital solutions. This move supports Mitsubishi Electric's shift toward digital engineering and addresses industry needs for easy-to-use systems amid rising labor costs and demand for efficiency, especially in India's growing manufacturing sector.

GLOBAL

Pilot Project Launched to Visualize Carbon Footprint Across Global Supply Chains

Partnerships

Mitsubishi Electric, NTT Communications, and SK Inc. C&C have launched a pilot project to visualize the carbon footprint (CFP) across global supply chains using the Catena-X data ecosystem. The project collects data from manufacturing equipment to automatically calculate and securely share CFP between companies. Focusing on lithium-ion battery production for electric vehicles, it aims to enable efficient, standardized data exchange while maintaining data sovereignty. Achieving SDGs, including decarbonization, requires connecting individual elements and utilizing supply chain-wide information. This initiative supports sustainable manufacturing and environmental goals.

JAPAN

Serendie Street Yokohama Powers AI-Driven Manufacturing Innovation

Innovation Hub

Mitsubishi Electric launched Serendie Street Yokohama, a state-of-the-art collaboration space in Yokohama, Japan, designed to accelerate innovation and digital transformation. The facility provides a dedicated environment for startups, industry leaders, and technology partners to develop next-generation automation solutions. Serendie Street Yokohama aims to foster open innovation, allowing companies to co-develop AI-powered manufacturing technologies, smart factory solutions, and industrial IoT applications. The space will also support joint research projects, facilitating real-world testing of cutting-edge automation solutions before full-scale implementation.

EUROPE

Composting Tech Cuts Food Waste at Radisson Blu Scandinavia

Sustainability

Mitsubishi Electric and Solserv AB have developed innovative composting machines that convert food waste into high-quality fertilizer within 24 hours, drastically reducing food waste at Radisson Blu Scandinavia. This technology tackles about 30% of landfill waste, cutting methane emissions and promoting a circular economy. The composters efficiently process organic waste year-round with odour control and energy-saving features. This sustainable solution improves soil health, conserves water, and supports global climate goals, while also helping Radisson Blu reduce food costs and enhance responsible business practices.

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

Technology with Heart, Designed for People.

Visualizing Human Work for the Future with Mitsubishi Electric's Behavioral Analysis AI.

A behind-the-scenes look at Mitsubishi Electric's AI technology that visualizes human movements on the manufacturing floor to support worker skill development and improve productivity. At the heart of this innovation, which can reduce analysis time for repetitive tasks by up to 99%, was a two-year journey to define the right development goals. This is more than just an automation tool—it's a new kind of support technology designed to empower people at the heart of manufacturing.

Beyond Automation Tools: Mitsubishi Electric's "Behavioral Analysis AI"

As skilled labour shortages and skill succession challenges intensify, visualising and optimising "human work" has become essential. To pass down tacit knowledge and speed up improvement cycles, quantifying motion with behavioural analysis is key.

Mitsubishi Electric's AI takes a distinct approach. Rather than replacing human insight, it converts areas traditionally reliant on observation and intuition into data—supporting judgement and improving workplace capabilities.

Toshiyuki Hatta
Sensor Information Processing Systems Department, Mitsubishi Electric's Advanced Technology R&D Center'

Yusuke Shimazaki
Solution Co-Creation Center of Mitsubishi Electric's Advanced Technology R&D Center

No Training Data Required - Automatic Motion Breakdown

Unlike traditional methods, this AI doesn't require pre-labelled training data. In daily tasks like screw tightening or part picking, creating such data would usually demand extensive labour and time.

Instead, the AI uses a probabilistic generative model. A few minutes of video and task duration input allow it to break down and classify work into "elemental motions," generating waveform data and video outputs automatically.

Laptop-Based Analysis - Quick and Lightweight

The AI's lightweight performance means all processing can run on a single laptop—no large system setup needed. Since no prior training is required, video input to result takes only seconds or minutes.

This enables quick on-site checks and immediate feedback, aligning perfectly with the needs of Kaizen and standard work reinforcement—areas often prone to individual variation.

Versatility in Training, Quality, and Safety

The AI extracts skilled worker motions and visually highlights differences and delays, enabling efficient skill transfer. In quality control, it detects variations in procedures and flags deviations early.

It can also identify abnormal motions from near-miss footage, supporting proactive risk detection and accident prevention.

Built to Support People

Developed by Principal Researchers Toshiyuki Hatta and Yusuke Shimazaki, this technology stems from a shared desire to create helpful, human-centred innovations.

Focusing the Goal - Reducing Analysis Time by up to 99%

Back then, behavioural analysis without training data was still rare. The team initially aimed for broad application but realised manufacturing urgently needed support with time-consuming motion analysis.

After visiting several sites, they found many tasks followed repeated procedures. By focusing the AI on these, they achieved analysis time reductions of up to 99%—results announced at IIFES 2024.

Exhibition Response and Future Vision

The team shared their findings at IIFES 2024 to encourage uptake and co-development, receiving strong interest. Mitsubishi Electric is now conducting trials with multiple companies.

Only When Released to the World Does It Become Truly Useful

Even the best technology is meaningless unless shared and applied. Turning a good idea into widespread utility takes time, effort, and perseverance.

The AI continues to evolve. Beyond productivity and quality, challenges remain in safety, ergonomics, and energy efficiency. But with ongoing development and a vision to help people, Mitsubishi Electric's engineers are committed to creating solutions that matter. ■

> Since I was young, I loved making things and entered a technical college with the desire to create robots that help people. After studying robot control and image/audio processing, I researched human body motion in a bioengineering laboratory during graduate school. At the core was a desire to create technology that helps people.

Toshiyuki Hatta
Sensor Information Processing Systems Department, Mitsubishi Electric's Advanced Technology R&D Center'

The departments, titles, and content mentioned in this article are as of the time of the interview (July 2024).

THE ART OF MANUFACTURING
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Supporting tomorrow's factory automation engineers

MECA is a global comprehensive educational support initiative provided by Mitsubishi Electric, designed to nurture aspiring engineers and equip them with the skills to excel in the field of factory automation (FA).

MECA

An educational initiative by Mitsubishi Electric

https://www.mitsubishielectric.com/fa/about-us/meca/

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