

Automotive Production

Automation Solutions

Improving productivity and lowering costs



Powertrain /// Press /// Weld /// Paint ///
Energy saving /// Final assembly ///

Meeting today's challenges



Production demands

We recognise that the modern automotive plant is an extremely demanding manufacturing environment. Companies who face competition on a global scale have to be able to address today's business challenges head on while managing risk.

- Increased production rates
- Higher product quality
- Greater production flexibility
- Increased operational safety

Meeting these requirements means looking at every aspect of the production cycle to see where productivity improvements can be made, driving down costs and improving plant performance. Maximising production line uptime and availability; increasing the rate of output; and minimising production faults and the need for costly rework are all critical to success.

Further, with modern automotive manufacture driven by customer requirements and the need to build in options to individual specification, flexibility on the production line has become vital. At the same time, stringent legislation has put the onus firmly on the manufacturer to guarantee the safety of personnel working in potentially hazardous areas.



Meeting industry needs

Boosting productivity, though, is only one side of the story. All sectors of industry are now under careful scrutiny to ensure not only that they are meeting individual customer requirements, but also addressing the wider demands of society and the environment.

- Reduced energy usage
- Reduced carbon emissions
- Demonstrable product traceability
- Protection of the local community

Today's energy prices have a significant impact on manufacturers' bottom lines, but reducing energy usage is also a priority for every environmentally responsible company. Increasingly companies will be judged on their environmental credentials, which means both saving energy and minimising the production waste that impacts on the environment.

Responsible manufacturers must also be able to show full traceability in the manufacture and distribution of their products so that any problem that impacts on the safety of customers can be traced back through the supply chain and forwards through the distribution and sales networks.

Improving productivity

Higher machine accuracy

Manufacturing products which are right first time means adopting processes that take a right first time approach. In terms of machining, this means processes which assure quality and minimise scrap or costly rework. The key to delivering this high level of quality is increased machine accuracy, which in turn depends on more sophisticated and more responsive machine control.

Higher production efficiency

The ability to machine to greater accuracy enables production rates to be pushed up without compromising quality, but increased production efficiency is also about maximising machine availability. One of the keys here is to minimise downtime.

Modern automation systems not only offer high levels of operational reliability, but also help to boost availability by providing early warnings signs of systems and parameters shifting out of tolerance. Self-diagnostics highlight the onset of problems at an early stage so that they can be dealt with at the most opportune time.

■ Powertrain

When parts are required to move at high speed and transmit considerable power, accuracy and precision have to be the watchwords. Accurate machining and precision assembly are critical.



■ Final assembly

Of all the activities in automotive build, final assembly requires the greatest expertise. Automation will assist in getting every aspect of the process right first time and therefore improve overall productivity.

■ **Press**

Press accounts for a large proportion of cost; initially developing the dies; running the plant and adapting it for model changes. Integrated automation aids both initial set up and on-going development.



■ **Weld**

Modern automation technology can be used to integrate control and safety functions into a single sophisticated system. This enhances overall efficiency and improves machine availability.



Greater design flexibility

Sophisticated control that boosts productivity can also deliver increased flexibility, enabling automotive production lines to accommodate multiple product variations and design differences. They can also simplify line changes to enable both subtle and significant product enhancements to be integrated from one model-year to the next, both quickly and cost-effectively.

Higher maintenance efficiency

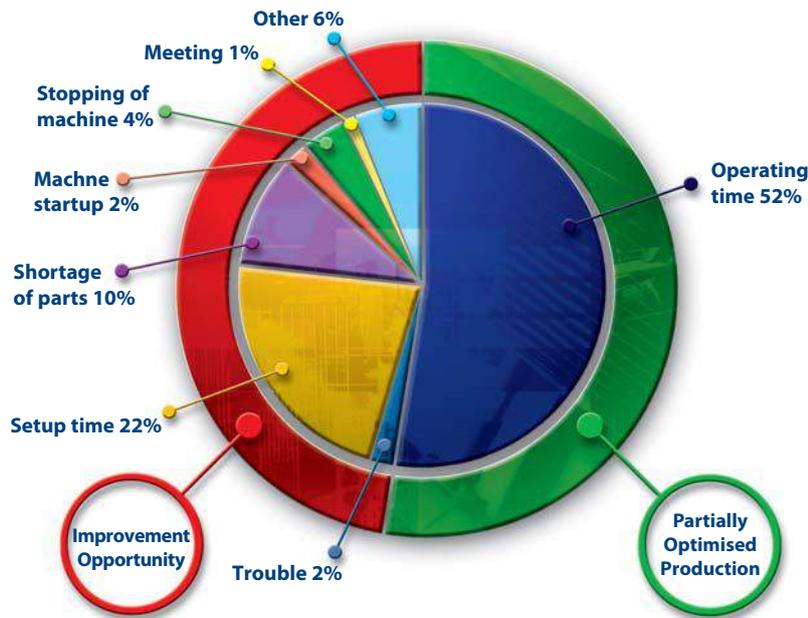
Minimising downtime and maximising availability is one side of the story, but every production line requires maintenance. The key to boosting efficiency is to be able to schedule maintenance instead of reacting to unplanned downtime. The diagnostics capabilities and sophisticated monitoring systems of today's automation products allow full maintenance data to be fed to higher-level systems. This enables manufacturers to move away from reactive maintenance that reduces overall line efficiency to a paradigm of predictive and proactive maintenance strategies.



■ **Paint**

Paint is a customer's first perception of vehicle quality. Manufacturers seek a competitive advantage with paint options. Environmental protection is also critical. Automation will efficiently balance all issues.

Better operational visibility



Agility and transparency

MES applications contain the critical business processes for executing a production schedule. These systems perform the production-centric functions of planning, controlling, operating and informing. Control systems execute these functions to produce vehicles as needed to meet customer requirements.

By integrating MES with control systems, automotive manufacturing becomes more agile for responding to changes in dynamic business environments. Integrating the control system with the MES allows for a more effective and broader set of production management functions to improve operational performance. It also gains critical transparency allowing management to understand key plant issues so that they can respond to them in a timely manner.

Improving productivity depends not simply on the control and automation equipment on the plant floor, but also on the way in which it integrates with higher level business systems to provide greater operational visibility. Driven by Manufacturing Execution Systems (MES), this increased transparency provides the information necessary for informed decision-making in real-time for all levels of personnel – from shop floor to top floor.





Leverage e-F@ctory for a highly optimised plant

Superior platform **Small investment**

Mitsubishi Electric's e-F@ctory concept for manufacturing systems provides a high degree of integration between usually separate automation disciplines. The objective is to create a better platform for the automotive industry, reducing risk and total cost of ownership.

The capital investment required to begin achieving some, if not all of the benefits of an e-F@ctory fully integrated manufacturing and enterprise system can be relatively small. Significantly most legacy/existing control systems can be utilised, avoiding the expense and disruption of wholesale change.

Intelligent networking

Using common systems, protocols and networks, such as the open CC-Link network architecture. Mitsubishi completely integrates plant equipment with business processes, so that they function as a single entity. This can be achieved either by using a single communications network or through the integration of multiple and disparate networks, including new build and legacy networks.

Mitsubishi's iQ Automation Platform is highly scalable, capable of accommodating anything from a handful of I/O channels up to several thousand. It can monitor, or map, all channels concurrently, which means that business functions can be integrated seamlessly with real time manufacturing performance.

More profitability

Mitsubishi's integrated manufacturing solution has already proved successful in several applications, including one of its own main factories in Japan where it has reduced costs, improved output and cut wastage. The improved Return On Investment (ROI) and reduction in Total Cost of Ownership (TCO) – critical in today's demanding automotive manufacturing environment – have improved profitability and ensured long term stability for the site.

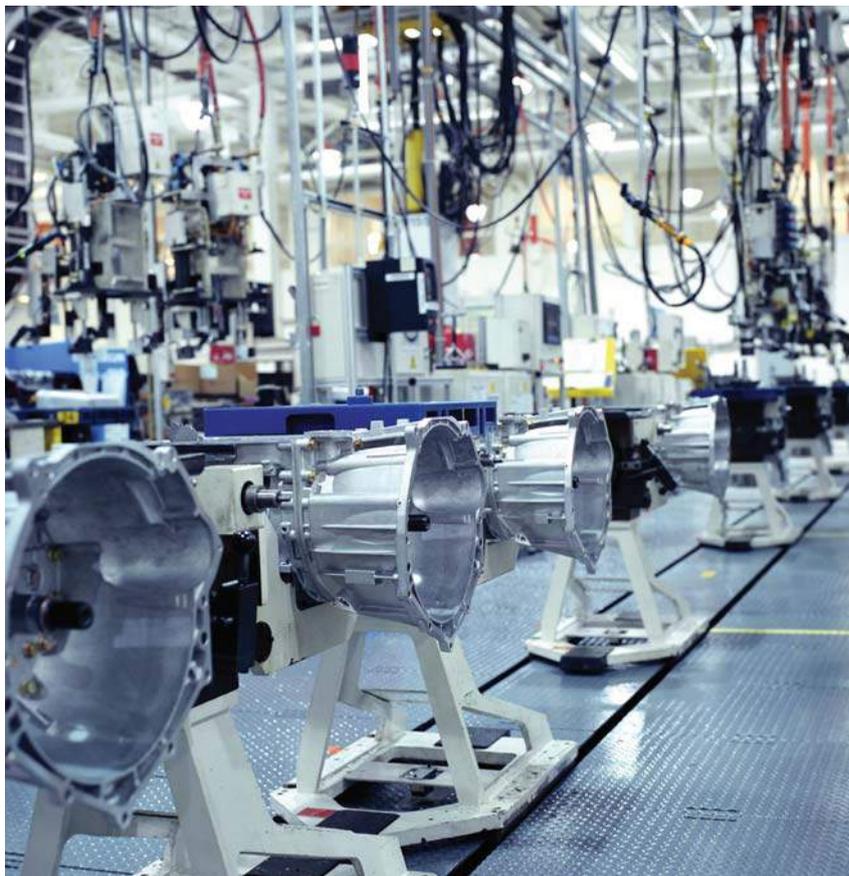
High precision, high productivity

Power train production is at the heart of any automotive business, and is a complex multi-faceted operation embracing many different processes, such as CNC metal cutting, materials handling, sensing, test and measurement. In order to meet demanding productivity objectives, accuracy, repeatability, consistency and precision must all be to the highest standard.

Traditionally a plethora of technologies have been deployed within power train production – CNC machines, motion control, tracking and tracing, gauging and measurement, sequence control, networked data collection. This makes for a high total cost of ownership and raises risks associated with designing, operating and maintaining multiple systems from different vendors that may not have been intended to work together. This can diminish and slow return on investment. Longer term, a poorly running plant has more difficulty justifying further capital investment making it difficult to remain abreast of changing market demands.

Single platform

Mitsubishi uses its expertise as a leading developer of control technologies to rationalise these varying forms of production control into a single system. This is based on the iQ Automation Platform, which supports dedicated systems for CNC, motion control, sequence control and information management on a single controller. This in turn is easily applied to plant operation, testing, materials transfers, data collection and analysis, production reporting and management information generation.



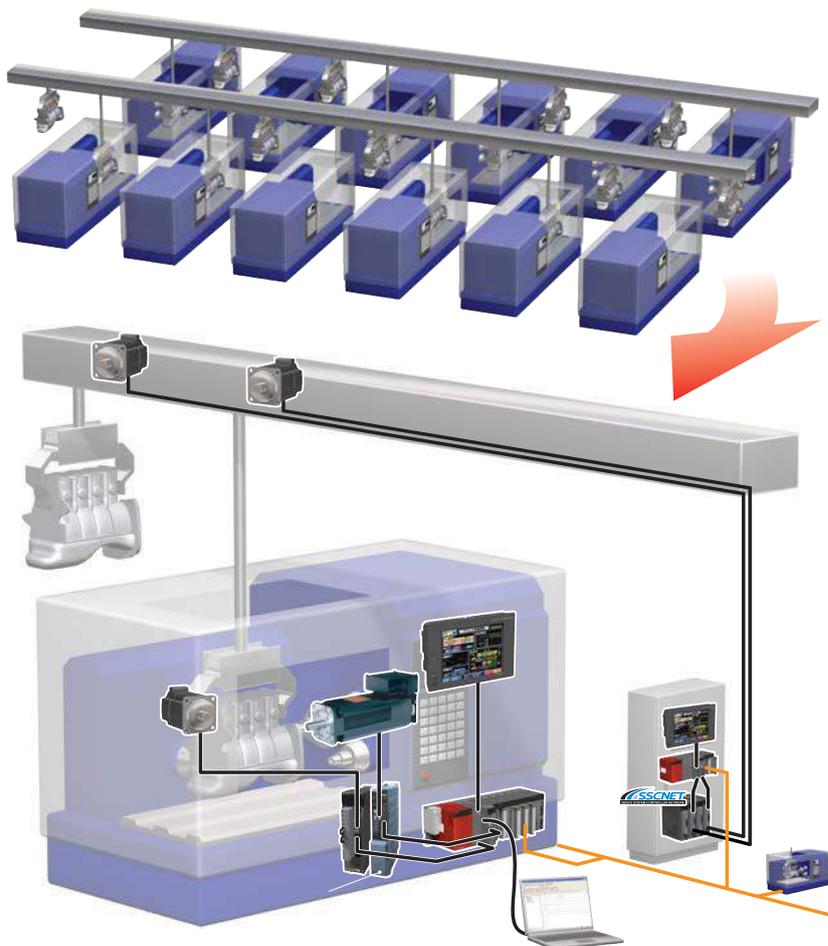
The iQ Automation Platform offers compelling TCO benefits in many powertrain applications

The TCO (Total Cost of Ownership) is reduced because cycle times are decreased, reliability and flexibility improved, maintenance simplified and ultimately product quality enhanced. Significantly, engineering of the production and business systems becomes far easier, and there is a reduction in spares inventory.

Greater than the sum of the parts

With every machine and system on the production floor producing a stream of high speed data, analysing this to produce appropriate and timely information is a major task. This is achieved through high speed open networks - for example gigabit CC-Link IE and specialist software such as SCADA (Supervisory Control And Data Acquisition) and MES (Manufacturing Execution Systems). Together these produce specialist reports on plant performance, production volumes, quality control, stock levels, etc in real time and deliver them to the machine operators, production engineers, maintenance technicians, financial staff, and senior managers instantly.

A decision can therefore be made to constantly optimise and reoptimise plant performance and production in a timely and efficient routine, without delays and missed opportunities. This allows production to be closely matched to actual market demand, for changing requirements to be addressed instantly and creates opportunities to reduce stocking levels, rework and scrap.



Improve productivity while simplifying design and maintenance of transfer lines by combining CNC, motion, sequence and data management on a single iQ controller.

Improve maintenance and reduce energy costs

Shorter start time

A large proportion of the manufacturing cost associated with automotive pressing lies in the design, build and tryout of the production dies, the automation of the supply of steel coil and handling of formed body panels. And this is not a one-off activity at the start of production; there is an on-going process of continuing change and improvement to adapt to model and design changes, enhance productivity and upgrade safety.

An integrated automation platform like Mitsubishi's iQ can ease overall system design, allowing pressing operations to begin as soon as possible. And changes can be achieved with the minimum of disruption to overall productivity.

Easier maintenance

One of the keys to maintaining productivity levels is the ability to manage maintenance in a proactive manner. The iQ Works software builds in maintenance as standard, vastly simplifying system management on a day to day basis. Powerful capabilities such as version management allow maintenance technicians to easily determine which system programs are the correct ones, while providing traceability of changes made to the system over time.



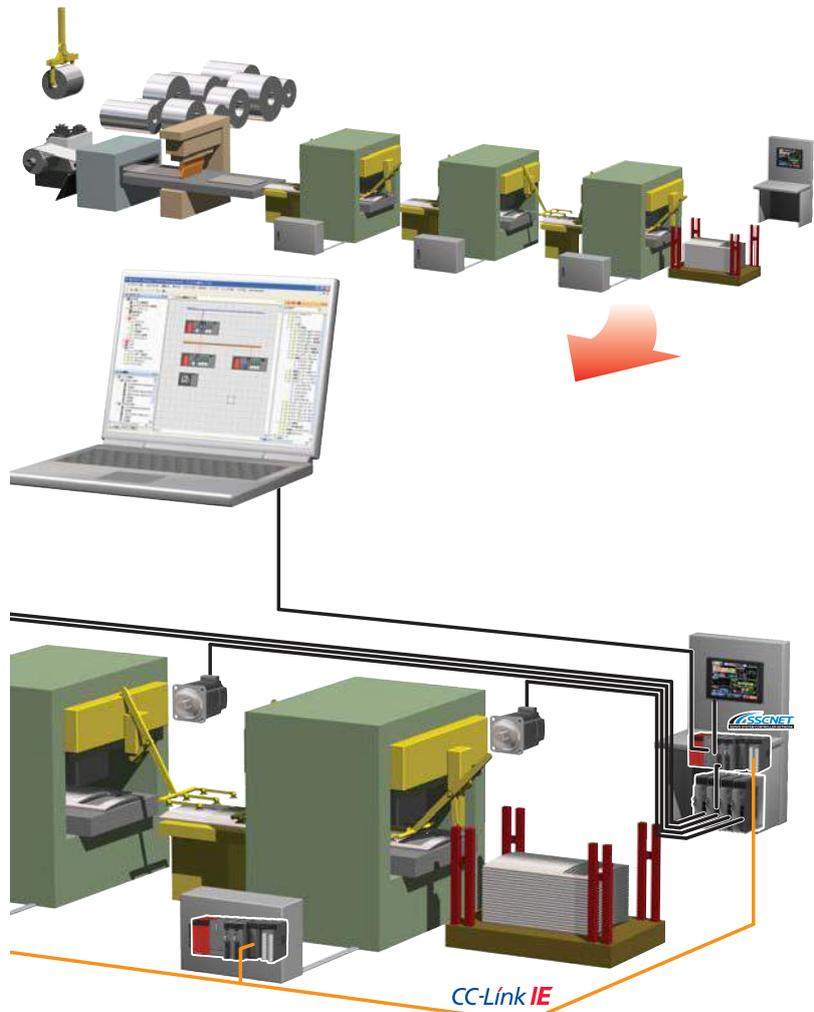
Improve press operations with an integrated solution from Mitsubishi

Integrated solution

A press shop combines many different functions, including materials handling and storage, as well as the precision press operations. Data management is critical because absolute traceability of finished panels is vital for efficient operations; inaccurate, incomplete or lost data will reduce productivity massively.

Within Mitsubishi's solution is every technology required for successful operations. Inverters such as our FR family offer energy saving benefits wherever motors are used, from the high power units running the press itself to the material handling systems taking raw material in and finished panels out. Precision servos such as the MR-J3 family run automated ASRS cranes for panels in temporary storage, while controllers such as the iQ Platform orchestrate the general operations and provide powerful data management abilities.

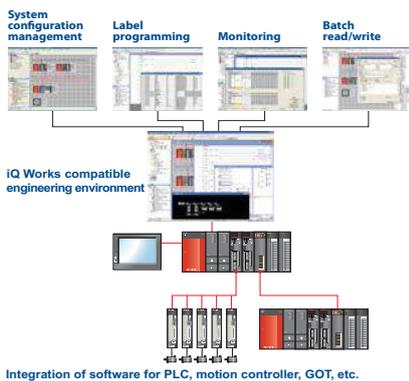
A comprehensive open network architecture such as CC-Link reduces wiring costs, simplifies maintenance and insures information is readily available where needed, when needed. This all combines into one highly efficient and flexible production system that is straightforward in its initial set up, reliable in operation and simple to reconfigure as changing market demands dictate.



High speed open networks combined with advanced engineering software tools allow consistently high panel output and proactive maintenance

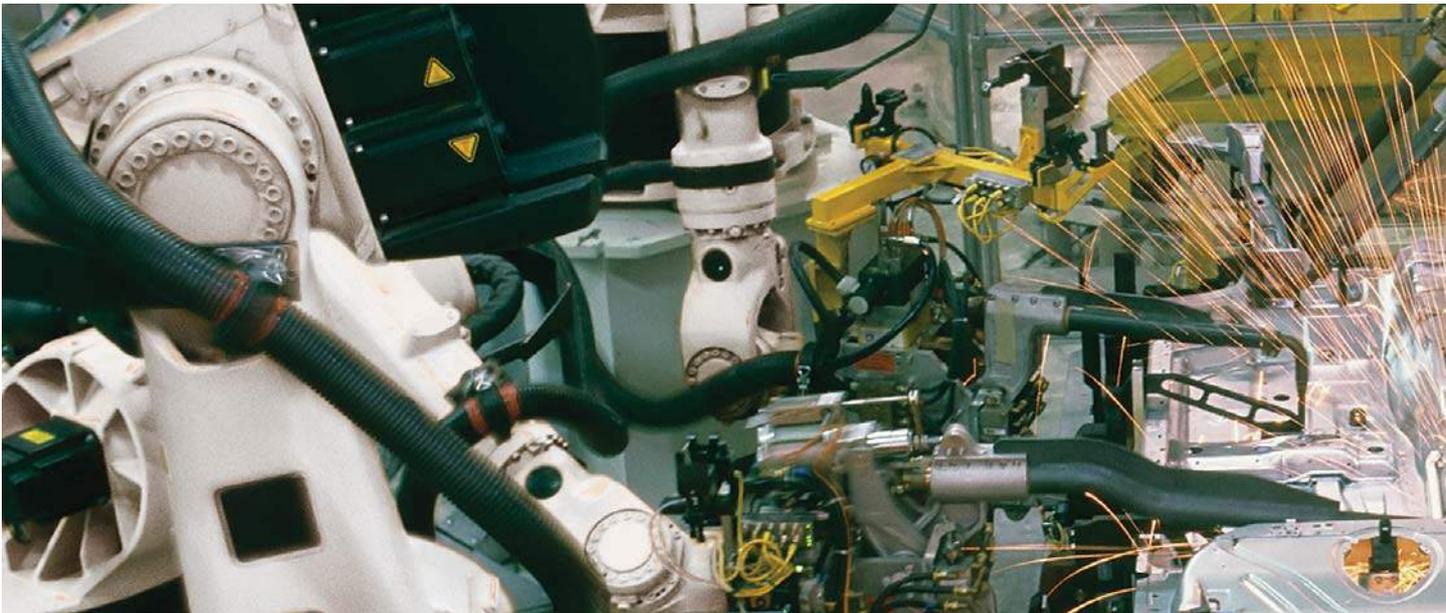
Reduced costs

Performing all of these functions in a single unified platform such as the iQ eliminates compatibility issues from one machine to the next, from one line to the next, and from one project to the next regardless of the passage of time between those projects. Hence ongoing plant investment can benefit from reduced engineering costs and easier project management.



Advanced software and hardware work seamlessly together for a complete press solution

Integrated safety and control



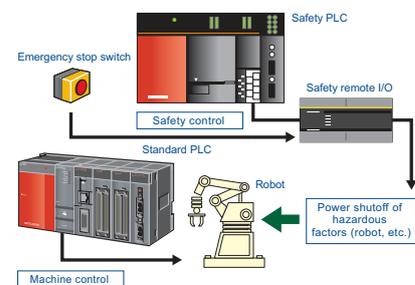
Efficient safety

In the modern automotive plant, safety and standard control often need to be highly integrated. Stringent safety legislation means manufacturers are under steadily growing pressure to demonstrate that they are doing everything possible to protect personnel. An integrated approach means that manufacturers can address safety requirements and productivity goals without conflict or compromise.

Safety systems must of course stop machinery in response to events where safety of personnel is paramount. Mitsubishi's integrated approach to machine safety enables the efficiency of automated processes to be increased while still offering the highest levels of safety to protect both operators and the machines themselves.

A portfolio of safety technologies and safety networking covers the whole spectrum of protection requirements that enable effective, integrated safety systems to be implemented simply and efficiently. They make it easy to adopt zonal approaches to safety, where an event on one aspect of the production line doesn't necessarily have to impact on upstream or downstream production.

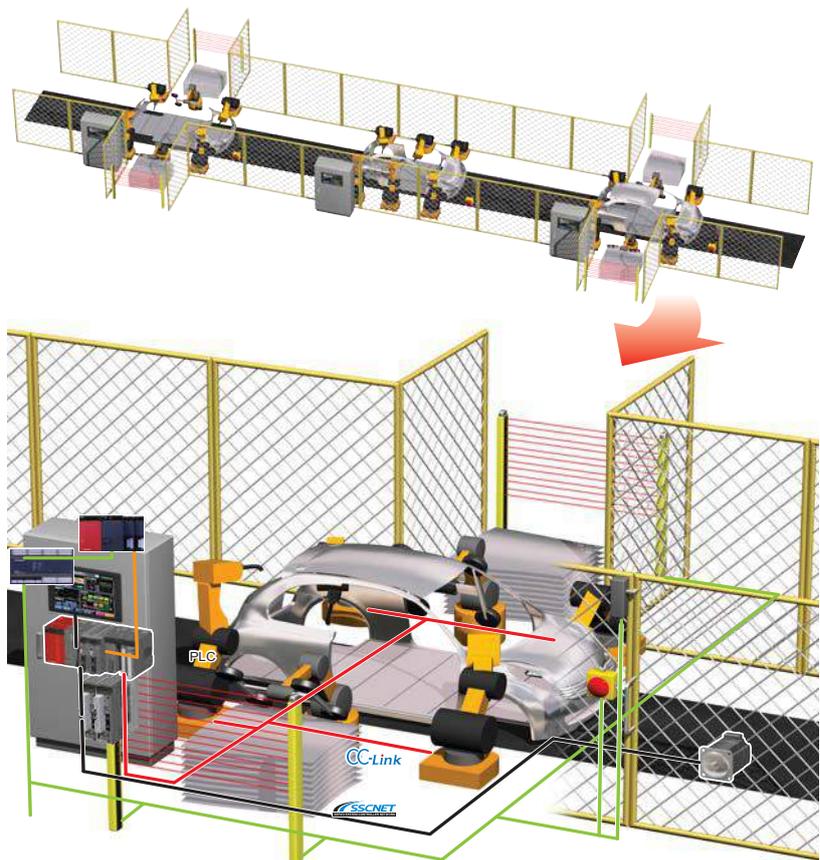
Incorporating open communications networks such as CC-Link allows both machine controllers and safety systems to be mixed on a single network. This provides tight coupling of safety and machine control to provide a unified approach to the automation of the whole production line. The CC-Link network architecture can also be extended to increase plant visibility, hence playing a key role in maximising machine availability on a plant-wide basis.





Protect with confidence

Core to Mitsubishi Electric's integrated safety strategy is the MELSEC QS safety PLC, delivering safety control compliant with IEC 61508 to SIL3, EN954-1 category 4 and ISO 13849-1. The close synergy between Mitsubishi Electric's safety and standard controllers, and its safety and standard control networks make it simple to implement all the safety related functions that are required in robot welding cells and to tie these systems in seamlessly with the standard control functions of the rest of the plant. In addition to the QS, Mitsubishi also offers safety relay technology that can be easily integrated with non-safety controllers such as System Q



Flexible safety solutions safeguard both workers and productivity

Protect quality and the environment

The paint shop is another critical process area in automotive manufacture. The finish is absolutely critical to the customer's perception of quality, and the variations in possible colours give manufacturers the opportunity to differentiate themselves.

Environmental compliance is increasingly important, while there is a constant drive to reduce wastage and therefore costs. As elsewhere, traceability has to be 100 per cent.

These combined requirements for high quality and maximum traceability place stringent demands on control systems.

Quality depends not simply on how well the paint is applied, but also temperature and humidity are critical aspects to be considered and controlled.

At the same time, automotive manufacturers must also focus on the impact of potential paint spray related pollution and take steps to neutralise potentially harmful emissions before they reach the atmosphere.

Mitsubishi can offer an integrated solution to address all these issues. Our System Q can combine precise control of paint temperature and booth environmental conditions with emissions compliance monitoring. The FR Family of inverters offers high power models that also offer maximum energy efficiency in airhouse fans. Our controller and network portfolio provides the necessary coordination between these systems and with the rest of the plant using the e-F@ctory technology of our MES interfaces. This insures the necessary data management capabilities to insure the required levels of process transparency and traceability.



e-F@ctory data management provides the traceability needed to insure precise colour matches between vehicle parts

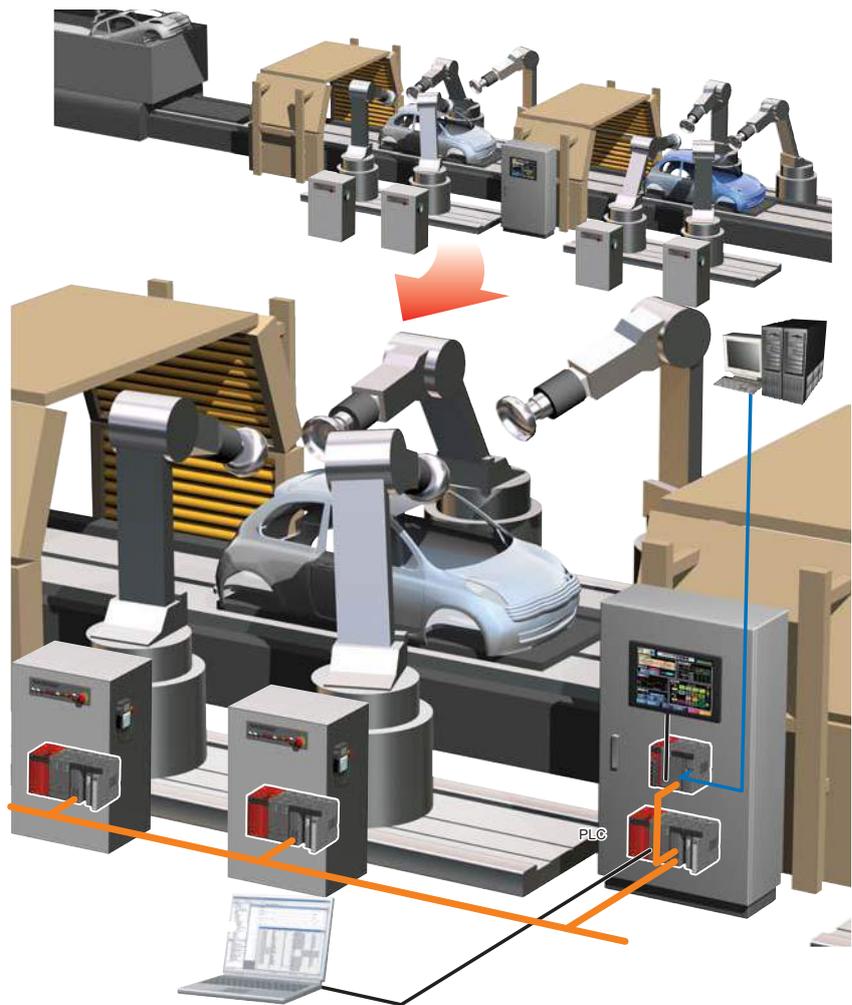
The right colour on the right body

With hundreds of different bodies passing through the booths in any given shift, it's critical to be able to manage large volumes of data correctly. Robot spray paths, correct colour application, body handling and worker safety parameters are just some of the key criteria that vary from model to model. With some plants having multiple different models pass sequentially down the line, a system able to handle this ever changing flow of work instructions and data is essential. Mitsubishi has a track record of handling these requirements in multiple plants across the globe with advanced controller and network technologies that meet these demands in a flexible manner.

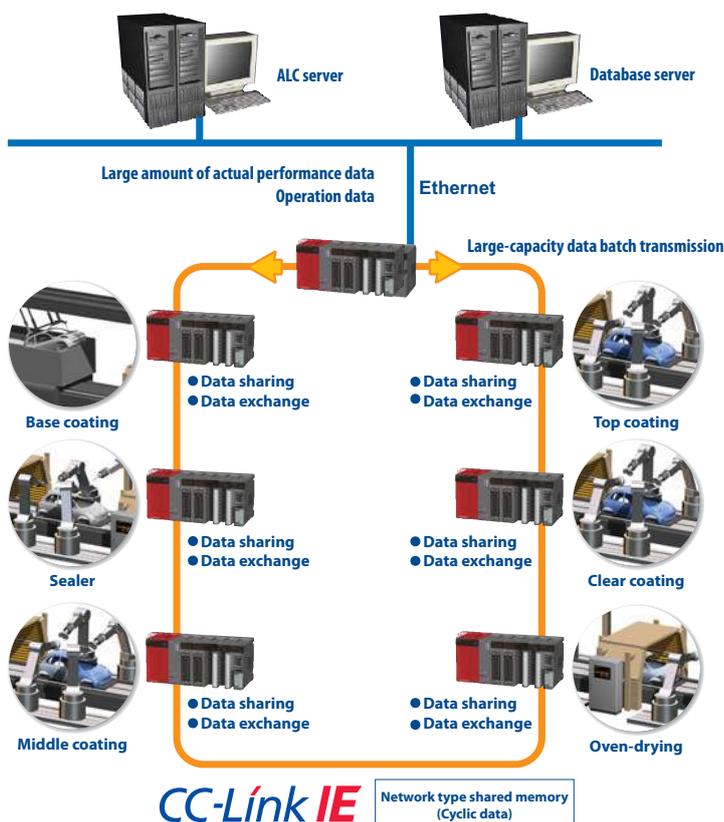
Better process coordination

PLCs such as System Q provide memory for vast amounts of data to be stored, shared and exchanged between the various coating and drying processes. This ability to share complex data easily is the key to improving paint shop productivity, enabling the different processes virtually to set themselves up based on the individual requirements of each body going through.

Simple set-up and configuration of paint lines is the key to smooth start-up and simplified maintenance, while line expansion is simplified when investment is required. Mitsubishi's innovative software tools make it easy to develop, duplicate and adjust programs in response to evolving business needs.



Maintain vital links between paint shop processes and MES systems



Improved visibility

This ability to handle such high volumes of data, and to move it around seamlessly between the plant floor and the wider enterprise systems deliver the visibility that is so vital to boosting productivity. Significantly, this is also where sales data becomes the dominant demand, matching individual vehicle specifications to customer orders.

The result is dynamic response to changes in production demand, a high degree of manufacturing flexibility, and the greatest levels of traceability throughout the manufacturing operation and the wider supply chain.

A transparent e-F@ctory network architecture based on CC-Link IE seamlessly links shop floor processes and IT systems

The right parts at the right time

Reduced mistakes

Final assembly is the point at which so many of the features that are unique to a given customer's order are incorporated in the vehicle, from engine variants to trim options to comfort features and more. Mistakes impact the bottom line through reduced productivity and re-work. HMIs networked to PLCs and the MES environment can provide operators with a 'fool proof' system for final assembly that can dramatically reduce the possibility of mistakes.

Problem solving

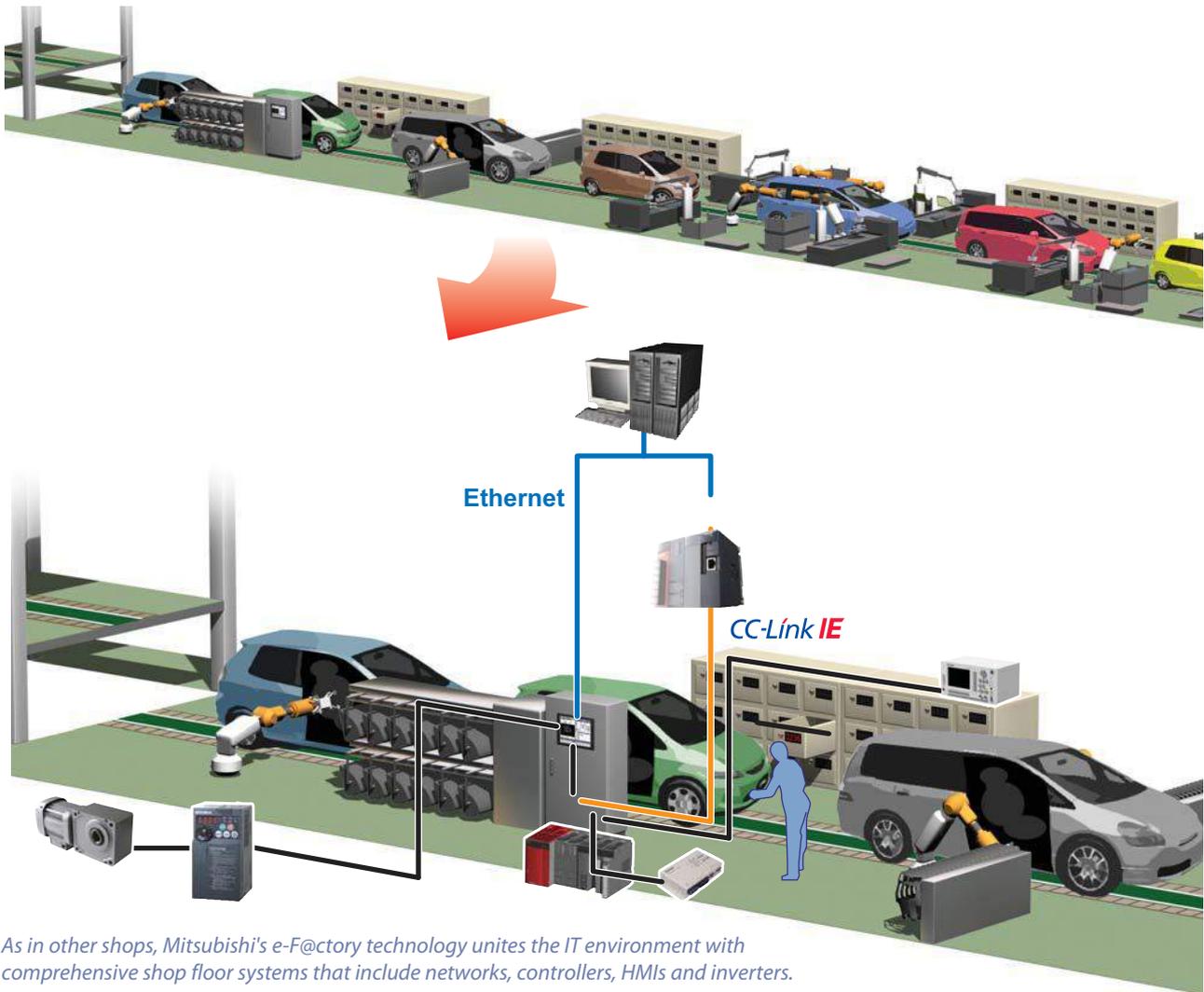
The same HMIs can also double as problem-solving terminals, eliminating the need to plug in diagnostic PCs, and enabling operators to diagnose and solve problems on the line as and when they occur. Allowing the operators to take local control and ownership of the line provides a big boost to productivity.

Reduced maintenance costs

HMIs that provide a window into the process also ease ongoing maintenance efforts, making it simple to implement predictive and proactive maintenance schedules. This holds the key to reducing unscheduled downtime and maximising line availability.



Manage the parts for thousands of variations of trim options more effectively



As in other shops, Mitsubishi's e-F@ctory technology unites the IT environment with comprehensive shop floor systems that include networks, controllers, HMI's and inverters.

Effective data management

Final assembly is perhaps the most challenging environment in the plant in terms of insuring the right systems have the right parts available at the right time. As hundreds of bodies pass down the line, literally thousands of combinations of trim levels must be accurately tracked and implemented on the right body in real time. At the same time, vital interaction between the line and MES systems insure the correct parts continue to arrive in the correct quantities as production continues. It is here where even minor discrepancies can halt the entire line if some required parts are not available when needed. The MESIF and eMESIF (MES interface and enhanced MESIF) of Mitsubishi's e-F@ctory solution offer the necessary capabilities to ensure these essential data management systems can be implemented in the right way for the line systems and plant systems already in place without costly re-engineering.

Long life design

To further reduce plant ownership costs, Mitsubishi Electric guarantees the integrity of the products themselves by using only the highest grade components and conservative ratings for the greatest reliability over long lifespans

Global and legacy support

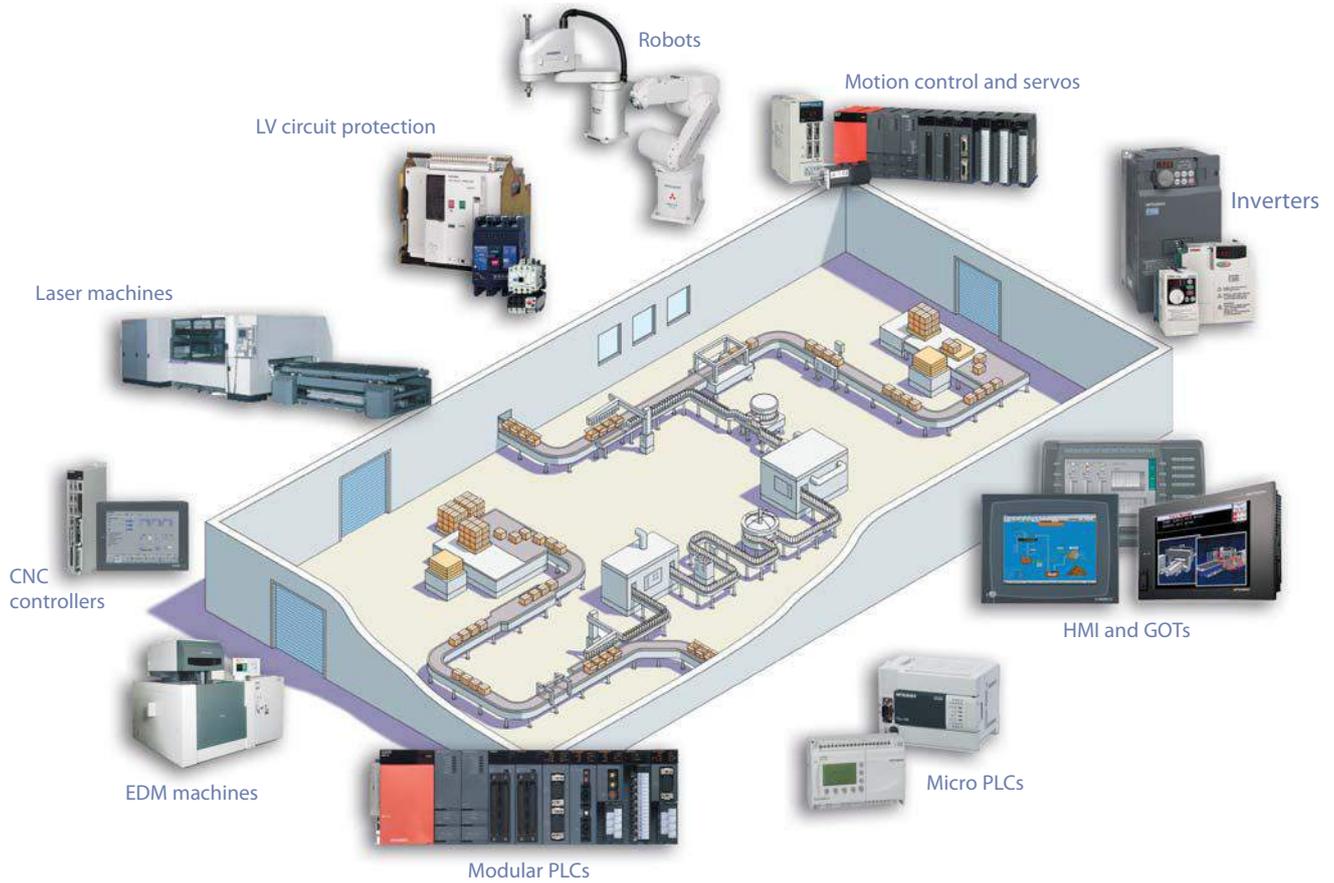


Automotive manufacture is a global business. Wherever you are in the world, Mitsubishi Electric is there to support you with a comprehensive range of consultancy, sales, back-up, training and repair services. With over 90 local sales offices and distributors in 51 countries, Mitsubishi Electric is both a local partner and a global resource. Manufacturers in all corners of the world rely on us for innovative, high-quality products, customised solutions, and support services.

With global sales of over \$30 billion and more than 100,000 committed employees, Mitsubishi Electric has the resources to deliver world-beating products that are reliable, efficient and easy to use.

Finally, with investments typically in the millions, it's essential to know the systems installed today will still be viable in the future. Mitsubishi has backwards compatibility as a core feature of its solution. Support for legacy systems continues for an extended period after official discontinuation, and convenient migration paths are offered. Sample evidence of this commitment is the way our current programming tools still support controllers from twenty years ago!

A world of automation solutions



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

A name to trust

The Mitsubishi brand is synonymous with the industry's most renowned PLCs, drives, servos, HMIs, I/O products, robots, PACs and higher level business solutions, seamlessly integrated with the world's fastest and most industrially rugged information networks.

Mitsubishi Electric products are widely regarded as being among the most innovative in the industry. In terms of volume, one in three PLCs in the world today is a Mitsubishi. Indeed, some of our competitors use Mitsubishi's innovative power management technology in their own frequency inverters. When all these factors are taken together, it is no wonder our customers think of Mitsubishi's automation products as leading the market.

Global Partner. Local Friend.



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