**MITSUBISHI ELECTRIC**

*Changes for the Better*

# 7 Quick wins for an agile manufacturing future

## Raising awareness of the need for smart manufacturing strategies

The Covid-19 pandemic, with its disruption to supply lines and unpredictable customer demand, really brought home the benefits of smart manufacturing strategies, with business realising that. However, taking advantage of them is a different challenge all together.

## Very distant goals of Industry 4.0

It is clear that for many businesses, with legacy assets and requirements for urgent investment in other areas, the goals of Industry 4.0 can seem further away than ever.
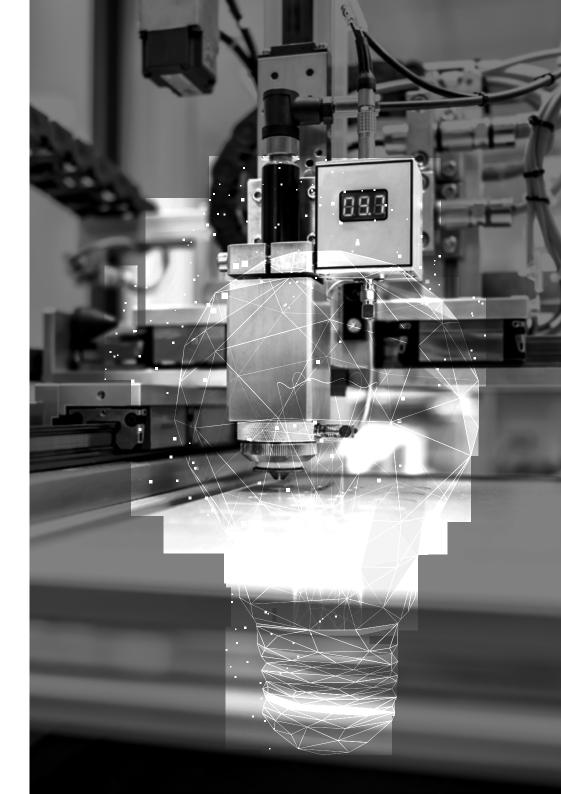Many of the smart manufacturing ideas and strategies that are discussed assume a base level of automation and integration that are much easier to achieve in greenfield sites that have been built to be smart from the ground up.
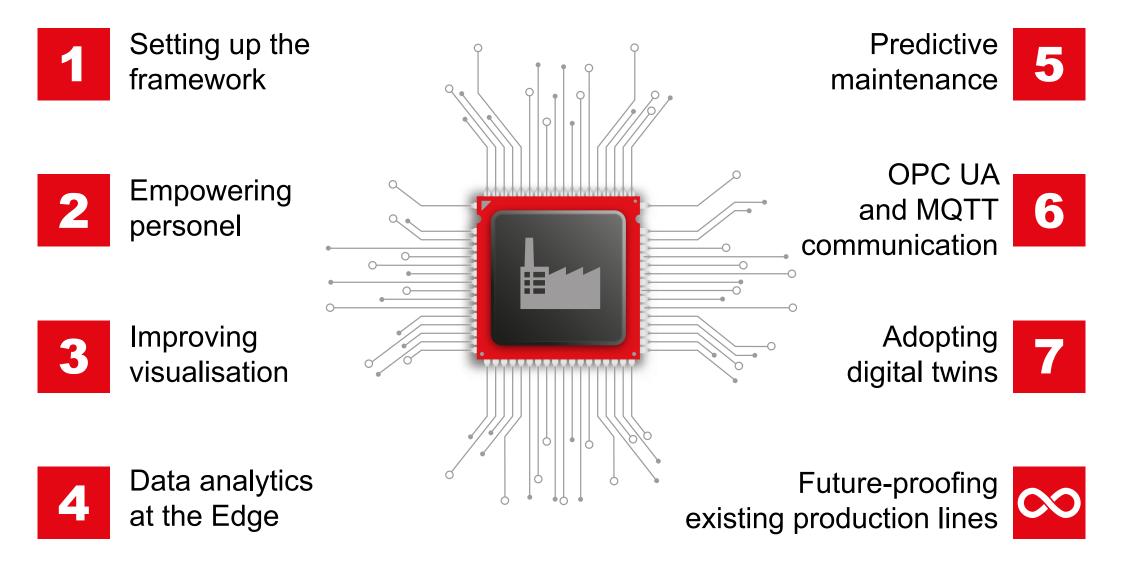
## The need to implement quick changes

When key areas of the plant might be in need of urgent change, it can be difficult to find the breathing space to focus on smart manufacturing strategies.

# A challenge for the agile manufacturing future

However, **there are a number of simple ideas that can be implemented with minimal time and cost** that can have a big impact on addressing today's manufacturing challenges.

# A smart way forward

**1** Setting up the framework

**2** Empowering personel

**3** Improving visualisation

**4** Data analytics at the Edge

**5** Predictive maintenance

**6** OPC UA and MQTT communication

**7** Adopting digital twins

**∞** Future-proofing existing production lines

# SETTING UP THE FRAMEWORK

# Setting up the framework

Even in the best manufacturing operations, it is quite possible to choose the wrong approach.

Actually have a negative impact on improvement efforts – and the bigger the change, the greater the potential risks.

Quite often, the quickest wins in optimising production environments come from the smallest changes.

To be able to spot these opportunities, you need to have a framework in place that enables you to benchmark where you are now and to set goals for where you want to be.

If you don't know the scale or cost of a project, it's hard to make the right investment decisions.

One option to help identify potential improvement opportunities is the Smart Manufacturing Kaizen Level (SMKL).

# Smart Manufacturing Kaizen Level (SMKL)

an evaluation model that looks at the level of data utilisation in manufacturing facilities.
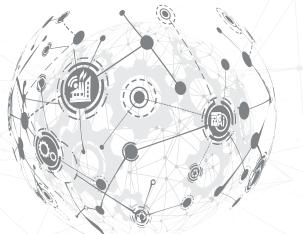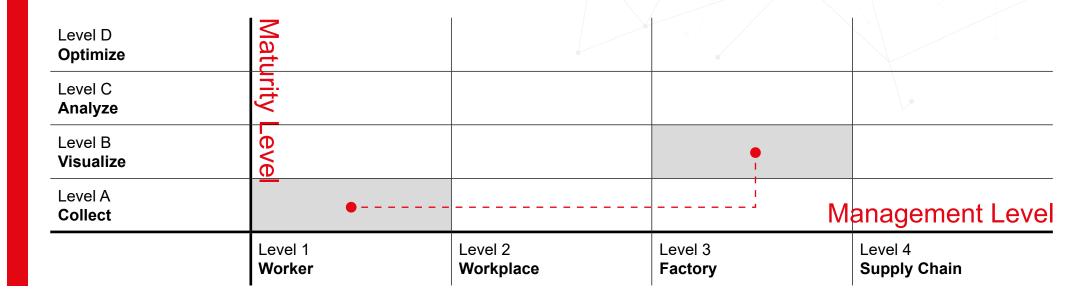
# Smart Manufacturing Kaizen Level (SMKL)

Starting with the collection of data in a given process, SMKL helps you define whether that process can be visualised or the data analysed, and subsequently how far the process can be optimised
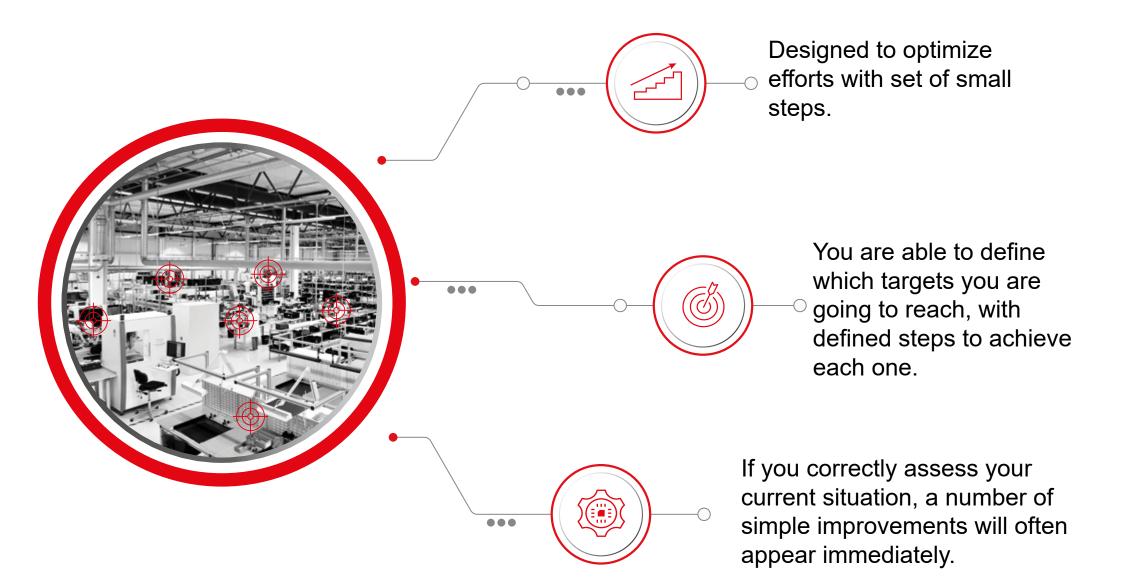
**Maturity axis**

The vertical 'maturity' axis provides goals for steadily improving individual processes.

**Management axis**

The horizontal 'management' axis defines the level of data granularity as you move from individual processes to a holistic view of the entire factory and on through the supply chain.

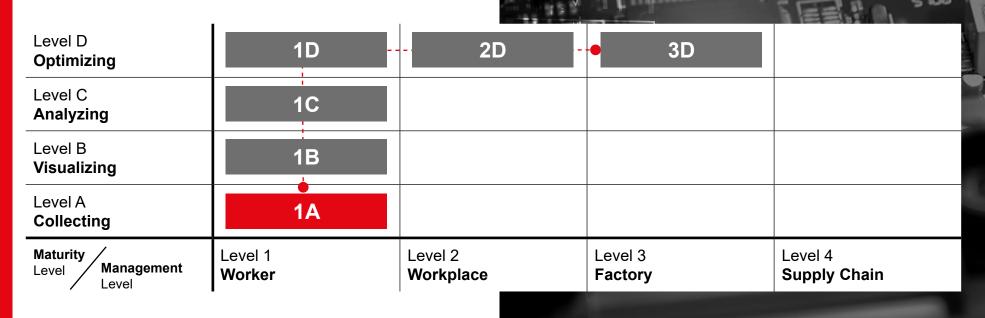| Maturity Level | Level 1 Worker | Level 2 Workplace | Level 3 Factory | Level 4 Supply Chain |
|---|---|---|---|---|
| Level D Optimize | | | | |
| Level C Analyze | | | | |
| Level B Visualize | | | ● | |
| Level A Collect | ● | | | |

Management Level

# SMKL is built on many small steps

Designed to optimize efforts with set of small steps.

You are able to define which targets you are going to reach, with defined steps to achieve each one.

If you correctly assess your current situation, a number of simple improvements will often appear immediately.

# EXAMPLE

**As an example, on an electronics assembly line:**

**1** ✓ The place to start would be to look at an individual machine cell or operator

**2** ✓ Next looking at the wider workshop, the factory and ultimately the supply chain.

**Only when you have collected data on the individual cell, visualised the process, analysed it fully and optimised that process, and achieved a target ROI, would you move onto wider areas of the plant.**

| Level D **Optimizing** | 1D | 2D | 3D | |
|---|---|---|---|---|
| Level C **Analyzing** | 1C | | | |
| Level B **Visualizing** | 1B | | | |
| Level A **Collecting** | 1A | | | |
| **Maturity** Level / **Management** Level | Level 1 **Worker** | Level 2 **Workplace** | Level 3 **Factory** | Level 4 **Supply Chain** |

**EMPOWERING PERSONNEL**

# Empowering personnel

Smart manufacturing is usually associated with data analytics and fully automated, interconnected machines.
**The reality, though, is that there is always going to be a degree of manual production.**
We can build on that expertise and combine it with automation to create a new manufacturing reality that maintains people at the centre of the plant strategy.

## Bring cobots into the working environment

One such strategy is to bring cobots into the working environment to increase flexibility in production, supporting human workers by taking over the repetitive tasks and the heavy lifting in manual processes.

The implementation of cobots alongside workers has been proven many times to make the production environment more flexible, as well as helping to reduce process errors.

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# Empowering personnel

The extent to which tiredness can impact on mistakes in manual operations is often underestimated, particularly where there is a high degree of repetition.

**Human workers are a huge asset to the company, so any technology that can be brought in to help them can solve a number of quality problems very quickly and at low cost.**

## Implement work navigation systems

Another strategy is to implement work navigation systems, again helping to improve quality in operator-led assembly processes.

## 1. Poka Yoke guidance systems

show workers the correct products to pick, while HMI-based instructions can guide the worker through an assembly process.

## 2. HMI-based instruction sets

eliminate the need, for example, for operators to remember multiple assembly processes across a number of different products.
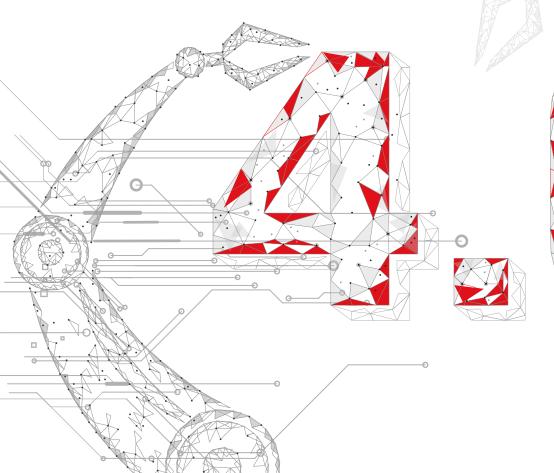
**BEST QUALITY**

- Poka Yoke pick-to-light technologies have been proven to significantly reduce errors in picking processes, which can impact on final assembly.
- Eliminating these errors early, long before the real value has been added to the product, saves money by reducing rework and waste.

- They provide step by step instructions for the worker for the specific product being assembled.

# People involved

- If they are, then they will be more accepting of the changes and often they will also become active participants in promoting them.
- With this acceptance and active participation, workers can be far more motivated, productive and effective.

What is vital, though, is to ensure that the people involved – the operators and assembly line personnel for example – are fully on-board with the new approaches.
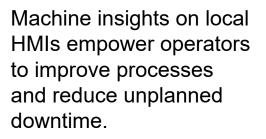
# IMPROVING VISUALISATION

# Improving visualisation

Visualisation of data can be a powerful tool to improve production, and it can have a big impact even at the local machine level.

Machine insights on local HMIs empower operators to improve processes and reduce unplanned downtime.

Improvements can often be made more rapidly and more efficiently than by relying on plant level data collection and analysis to reveal insights.

Setting this up is often a case of plug and play, with Mitsubishi Electric for example, offering a dedicated library of visualisation tools on its GOT range of HMIs for the likes of motion, robot and inverter applications.

It's also a simple matter to make the same visualisation data available to higher level enterprise applications or the cloud for deeper analysis that can drive productivity improvements.

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GOT2000
Graphic Operation Terminal

GOT SIMPLE
Graphic Operation Terminal

# DATA ANALYTICS AT THE EDGE

When we think about data analytics, what comes to mind most often is some IT-level platform, collecting and analysing data from the whole plant, **with data scientists carefully preparing advanced algorithms to derive meaningful insights. Certainly those systems have a key role to play and can have a huge impact in driving up productivity**. But they need time and money to deploy.

# <span style="color:red">Data analytics</span> at the Edge

# Data analytics

## Generating useful data

For the quick fixes, we can look at data analytics on a smaller scale. With every machine, controller and smart device generating useful data, the ability to use that data in real time to drive optimisation on the plant floor can provide tangible benefits. This is where edge-level data analytics comes into play. It is simple to implement on even the smallest scale applications, yet easily scalable over time to address more complex analytical requirements.

## Edge analytics

Without the need for any existing advanced networking architecture, edge analytics enables us to start small, perhaps just on a pilot project. The edge computer aggregates and filters the data, eliminating the traditional IT-related consideration, and runs the analysis algorithms locally to reveal the useful information that can drive up productivity.

**EXAMPLE**

**① Data analysis platform**

Mitsubishi Electric's MELIPC, with its **real-time data analyser software**, is a platform that can be used in such applications.

**② Integration with the production environment**

It is easily integrated into the production environment and **doesn't require access to an IT-level LAN network**.

**③ Removes the needs for data science specialists**

It also removes the need for data science specialists in order to implement meaningful change: **keeping the analysis local to the production environment improves speed of response** and makes the analysis results easy to interpret for production engineers.

**Mitsubishi Electric's MELIPC**

# PREDICTIVE MAINTENANCE

# Predictive maintenance

Maintenance is often a sensitive subject for discussion; while every plant will almost certainly have a maintenance regime in place, these are often not as efficient or effective as we might think.

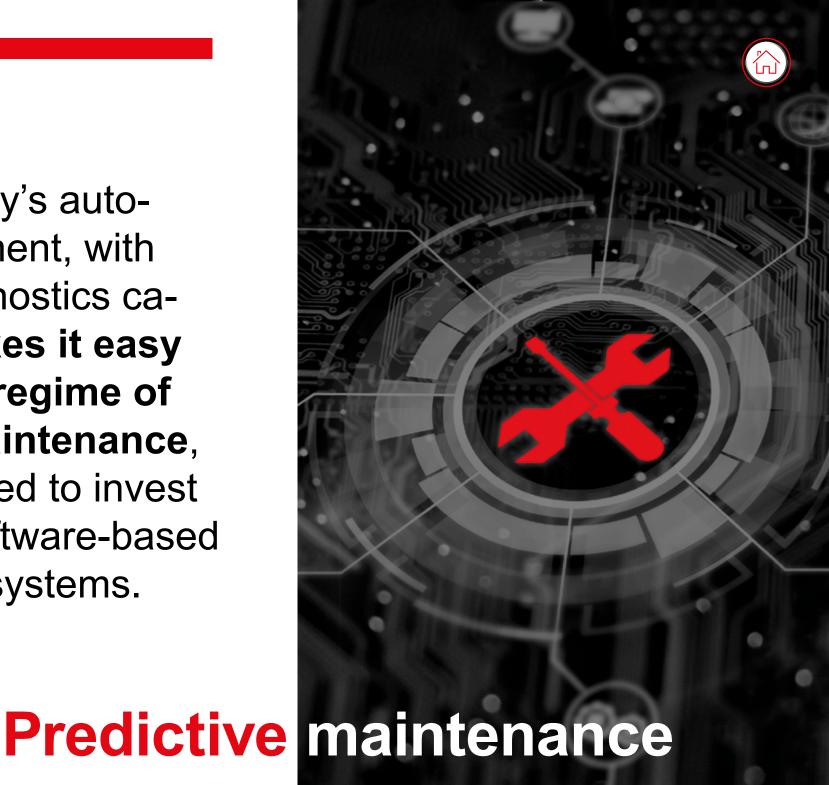**1** There are still many plants that rely on preventative maintenance to keep lines at optimal efficiency

**2** Reactive maintenance practices incur the penalty of unscheduled downtime

**BOTH CAN IMPLY SIGNIFICANT COSTS**

However, today's auto-mation equipment, with its inbuilt diagnostics ca-pabilities, **makes it easy to move to a regime of predictive maintenance**, without the need to invest in complex software-based maintenance systems.

## Predictive maintenance

1. Modern inverters, for example, understand the expected characteristics of their loads and can flag up potential problems long before they occur.

2. Most recently, inverters such as Mitsubishi. Electric's E800 range have offered the capability to detect corrosion of their internal PCBs, providing additional preventive maintenance information for products operating in harsh environments.

3. Similarly, today's motion control products such as servo amplifiers can monitor and recognise developing issues with the likes of belts and gears, while robots can monitor their internal components for wear.

**Mitsubishi Electric's E800**

With all of these products, the equipment offers diagnostic capabilities as inherent embedded functions, **enabling preventive maintenance strategies to be adopted at no extra cost**, significantly reducing the possibility of unexpected downtime.

## Hassle-free use of equipment

# OPC UA and MQTT COMMUNICATIONS

# Challenge

**1** ——

Brownfield applications tend to have implemented different networks over time in different areas of the plant.

**2** ——

This can make network integration look like much more of a challenge.

## Network protocols such as OPC UA and MQTT are the solution.

# OPC UA

- It is already widely used in manufacturing, especially in integration between field-level automation systems.
- It also provides a future-proofed protocol as it is supported by numerous suppliers in a whole range of equipment types.
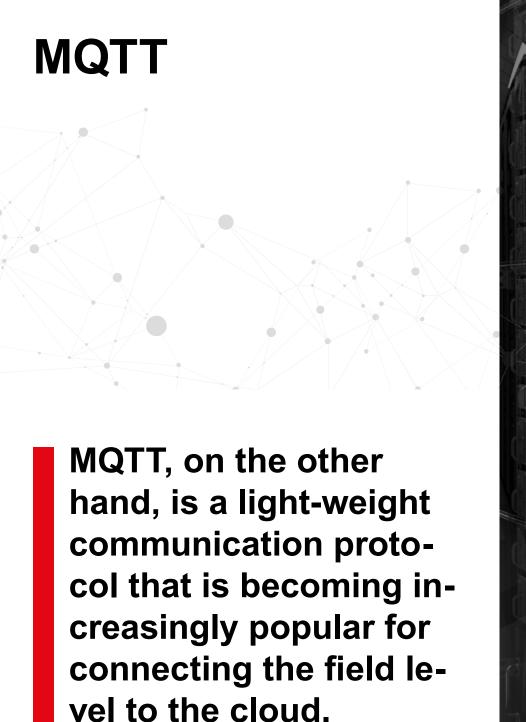
INDUSTRY 4.0

# MQTT

MQTT, on the other hand, is a light-weight communication protocol that is becoming increasingly popular for connecting the field level to the cloud.

# You decide on the scale, by...

Using dedicated, light-weight function blocks in order to provide MQTT connectivity to compact and low-cost machines

Using edge-level gateways to interconnect production lines with IT systems using either MQTT or OPC UA, or both

Adopting a special hardware-based OPC UA server as part of the control platform in order to provide high-performance communications

# OPC UA MQTT

**Advanced and powerful.**

**Yet easy to implement even on existing manufacturing lines.**

**They enable you to choose an integration strategy that best fits your individual requirements,** perhaps by starting on specific areas of the production line or creating a central data-concentration hub.
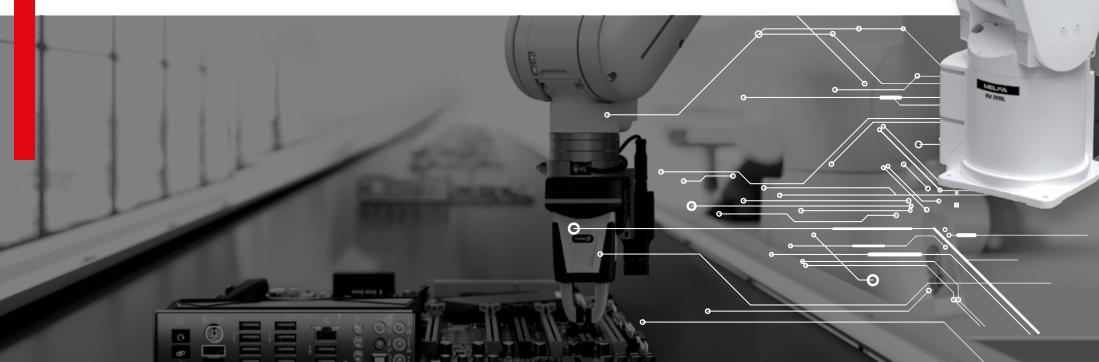
# ADOPTING DIGITAL TWINS

# Using Digital Twin technology to optimise upgrades

Digital twinning technology comes in a variety of formats and can definitely represent a quick win when looking at plant upgrades. An obvious case is implementing robots; some industrial robot vendors (Mitsubishi Electric included) provide programming and planning software that allows production scenarios to be built up in 3D visualisations that show how each robot arm will interact with the immediate environment and each other. Productivity can also be accurately predicted for new robots and other factory automation upgrades, leading to reliable ROI data before purchase. Running simulation models for the entire production line, and even further along the supply chain, can also speed-up production improvements and upgrades both physically and through the sign-off and build phase.
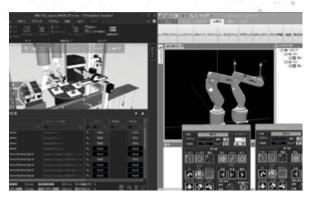
**GEMINI**, new powerful simulation software provides full integration between software and the real equipment.



Enables simulations of people/robot/AGV flow lines and operating ratio



Advance checks of mechanical interference in 3D



Connect with control devices for advance check of control logic

THE STORY CONTINUES...

FUTURE-PROOFING
EXISTING PRODUCTION LINES

# Future-proofing existing production lines

## Rapid changes

Rapid change has been a characteristic of the manufacturing sector in recent years, driven by increased global competition.

## Production line paths?

It means standing still is not an option. There will always be several paths available when it comes to making production lines more flexible and these don't have to imply a huge investment.

## Quick wins

By focusing on the quick wins, businesses can realise significant improvements in productivity and create more agile manufacturing processes.

# EMEA offices

**Mitsubishi Electric Europe B.V. Germany**
Mitsubishi-Electric-Platz 1
D-40882 Ratingen
Phone: +49 (0)2102 / 486-2048

**Mitsubishi Electric Europe B.V. Czech Rep.**
Pekařská 621/7
CZ-155 00 Praha 5
Phone: +420 734 402 587

**Mitsubishi Electric Europe B.V. France**
2, rue de l'Union
F-92565 Rueil Malmaison cedex
Phone: +33 1 41 02 83 00

**Mitsubishi Electric Europe B.V. Hungary**
Madarász Irodapark, Madarász Viktor u. 47-49.
HU-1138 Budapest
Phone: +36 70 3322 372

**Mitsubishi Electric Europe B.V. Ireland**
Westgate Business Park, Ballymount
IRL-Dublin 24
Phone: +353 (0)1 4198800

**Mitsubishi Electric Europe B.V. Italy**
Viale Colleoni 7 Palazzo Sirio
I-20864 Agrate Brianza (MB)
Phone: +39 039 / 60 53 1

**Mitsubishi Electric Europe B.V. Netherlands**
Nijverheidsweg 23C
NL-3641RP Mijdrecht
Phone: +31 (0) 297 250 350

**Mitsubishi Electric Europe B.V. Poland**
ul. Krakowska 48
PL-32-083 Balice
Phone: +48 (0) 12 347 65 00

**Mitsubishi Electric (Russia) LLC Russia**
2 bld. 1, Letnikovskaya st.
RU-115114 Moscow
Phone: +7 495 / 721 2070

**Mitsubishi Electric Europe B.V. Slovakia**
Levická 7
SK-949 01 Nitra
Phone.: +421 917 624036

**Mitsubishi Electric Europe B.V. Spain**
Carretera de Rubí 76-80 Apdo. 420
E-08190 Sant Cugat del Vallés (Barcelona)
Phone: +34 (0) 93 / 5653131

**Mitsubishi Electric Europe B.V. (Scandinavia) Sweden**
Hedvig Möllers gata 6
SE-223 55 Lund
Phone: +46 (0) 8 625 10 00

**Mitsubishi Electric Turkey Elektrik Ürünleri A.Ş. Turkey**
Şerifali Mahallesi Kale Sokak No:41
TR-34775 Ümraniye-İSTANBUL
Phone: +90 (216) 969 25 00

**Mitsubishi Electric Europe B.V. UK**
Travellers Lane
UK-Hatfield, Herts. AL10 8XB
Phone: +44 (0)1707 / 28 87 80