

# GAMBICA

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# KNOWLEDGE - INFLUENCE - COMMUNITY

**T**hank you for picking up this publication – I am really pleased that you are taking a look at what GAMBICA is doing. We are very proud to be the voice of our industries and are always delighted to engage everyone in our vibrant community.

Our industry continues to face unprecedented opportunities challenges. GAMBICA will continue to be focus on helping you take advantage of the positives and mitigate the threats.

Industrial strategy is a priority for the UK government, bringing with it sector deals such as 'Made Smarter', funding calls for innovation and digitalisation, and policy changes in areas such as export support, apprenticeships and energy efficiency. GAMBICA is highly engaged with driving this agenda, creating opportunities for members.

Political uncertainty remains a major challenge, which is why GAMBICA helped to set up the EURIS Task Force. This is a multi-

association industry collaboration which advises government on the impacts of Brexit and seeks to eliminate the risks of trade barriers, administrative burden, regulatory divergence and other pitfalls in the complex relationship between the UK and EU (for more on EURIS, see page 45).

These and other factors mean that it is as important as ever to maximise our influence in international and European standardisation through membership of BSI, CENELEC and the IEC, and in the regulatory arena, where we continue to provide expertise and leadership through membership of European trade associations.

We cannot achieve all of this without the active support of our members, therefore I would like to invite you to add your voice to our community and to use this insight and knowledge to push your business forward. Together, we achieve more than we ever could alone. ■

**Steve Brambley, CEO**



## GAMBICA'S MISSION

**O**ur mission is to deliver value to our members in the Instrumentation, Control, Automation and Laboratory Technology sectors.

Our insight and influence help our members to be more competitive by increasing their knowledge and impact. Together we remove barriers and maximise the market potential in our industry.

## GAMBICA

- We form a community of members and stakeholders that shares knowledge and best practice, shapes opinion and enhances the profile of our sector
- We influence policy, standards and regulation for the benefit of our industry
- We publish unique market reports and forecasts, allowing members to accurately plan future strategies and budgets
- We help members develop business by promoting our industry through exhibitions, events, publications and media campaigns

# STATISTICS

A key service that GAMBICA offers its members is the collection and analysis of data for the markets that it covers. It also works with leading economists to predict future trends.

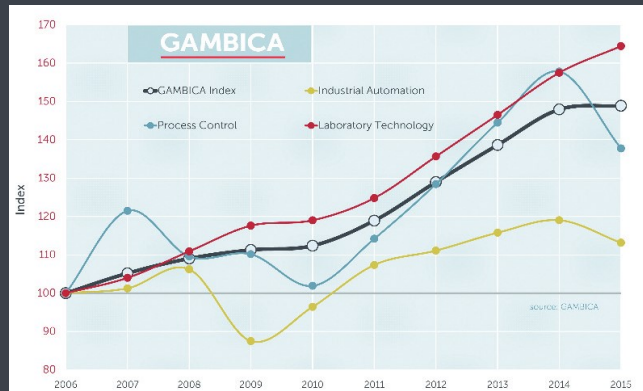
Twice a year (in April and October), GAMBICA hosts an economic and political update event, presented by Oxford Economics – one of the world’s largest and most respected economics companies. This authoritative economic and market data report, commissioned specially by GAMBICA for our members, gives an economic growth forecast for the UK and world economies and provides an outlook for several major sectors. The biannual event and the accompanying report are widely regarded as a great advantage for planning future market strategy and forming budgets.

As good as Oxford Economics is, it is GAMBICA which provides our members with the data that lets them benchmark against the rest of the UK Industrial automation market. We run monthly and quarterly market data collection and report back to participating members aggregated industry-wide data by sector, product, size or ratings.

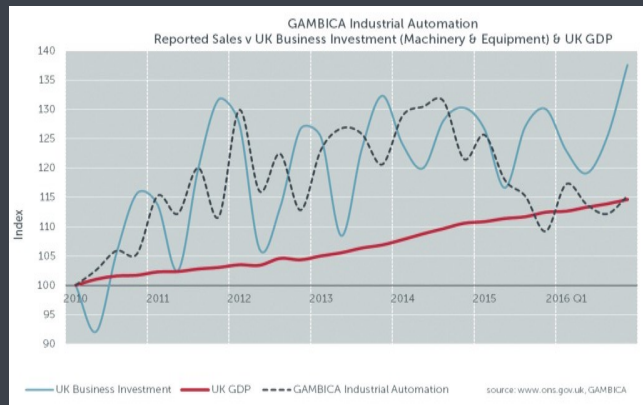
Currently, market data collections take place for the following product groups in the industrial automation sector:

- Variable-Speed Drives
- Controlgear
- Automation Products
- Interconnection Technologies
- Soft Starters
- Motors
- Machine Safety Components
- Electronic Positioning Sensors
- Encoders

GAMBICA also runs surveys with our members on topics that let them benchmark against the rest of the sector, be it on salaries and benefits or market shares.



GAMBICA produces indices that indicate how its various sectors are performing



GAMBICA’s services include financial statistics on the markets in which its members operate



GAMBICA issues regular reports on aspects of the market and their implications for its members

# EXPLORE THE FUTURE OF DIGITALISATION

Join us on 18 September at The British Motor Museum, Warwick ([52.1889° N, 1.4803° W](#)) for the Smart Industry Experience – a complimentary day exploring the implementation of the latest digitalisation solutions within the manufacturing sector. Discover how leading organisations are approaching and implementing Smart Manufacturing and how this could benefit your business.

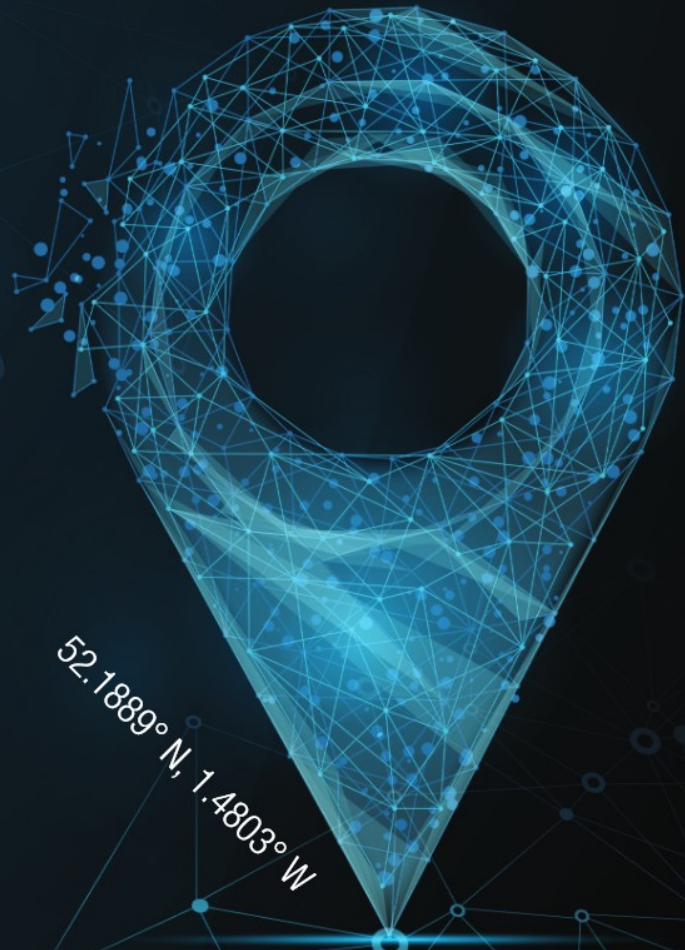
## SPEAKERS

- **UK Manufacturing** – Dept. for Business, Energy & Industrial Strategy
- **Logistics** – Amazon Web Services
- **Utilities** – Severn Trent Water
- **Automotive** – Nissan UK
- **Process Industry** – Orbital
- **Infrastructure** – Telent

Ideal for business leaders, senior managers, production directors and end users. If you're trying to navigate the implications of digitalisation for your business this is an event you can't afford to miss.

Places for the Smart Industry Experience are extremely limited. Register now at [gb3a.mitsubishielectric.com/SIE](http://gb3a.mitsubishielectric.com/SIE) to reserve your ticket.

Hosted by Mitsubishi Electric UK supported by Manufacturing Management and The British Motor Museum.



## SMART INDUSTRY EXPERIENCE

18 SEPTEMBER 2019 | BRITISH MOTOR MUSEUM, GAYDON, WARWICK

NAVIGATE TO THE EDGE OF DIGITALISATION

COMPLIMENTARY TOURS OF  
THE MUSEUM WILL BE AVAILABLE  
ON THE DAY.

# INDUSTRIAL AUTOMATION TECHNICAL COMMITTEES

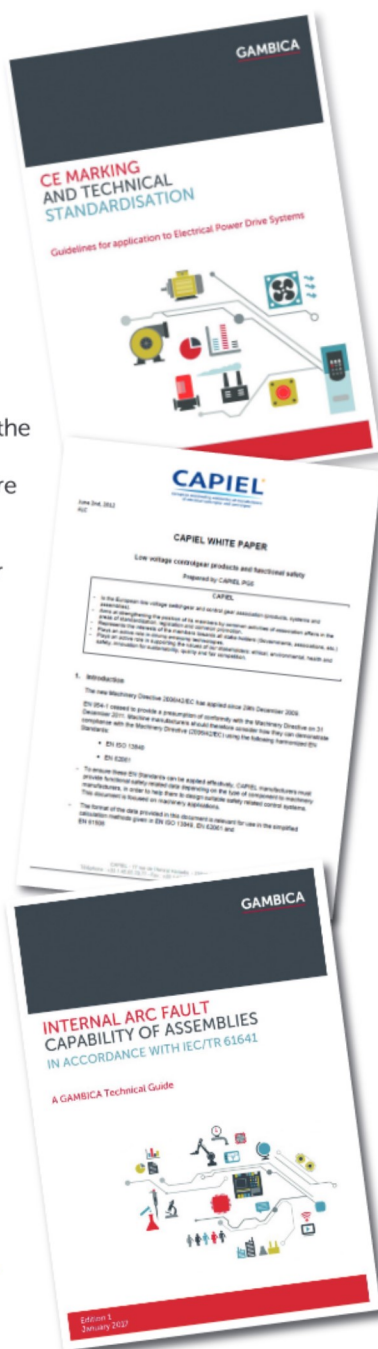
The GAMBICA Controlgear and Variable Speed Drives Technical Committees (TCs) are groups of technical experts from the member companies that serve the interests of the group members in national and international standardisation, regulations and directives.

They are forums where our members have the opportunity to be kept up-to-date with the latest activities on the standards and regulations applicable to their products, via the standards-makers themselves – GAMBICA members represent the organisation on more than 100 standards committees, making GAMBICA ranked 2nd by BSI. The TC members also interact with European sector organisations (CAPIEL for controlgear, and CEMEP for VSDs) and, through these activities, are engaged in developing and amending regulations and directives.

Not only do the TCs give an opportunity for information about standards and regulations to be disseminated to the member companies but, in turn, they give the members the place to comment and input into those same standards and regulations.

The Controlgear and VSD Technical Committees are also keen to share their knowledge and regularly produce guidance documents with the aim of clarifying or simplifying the standards and regulations affecting their industry.

**These guides are free for anyone to download from the GAMBICA Web site.**



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# GAMBICA

**Representing the Instrumentation, Control, Automation and Laboratory Technology industries in the UK**

<p><b>200+</b> Members</p> 	<p>Industry turnover</p> <p><b>£6.9b</b></p> 	<p>Export value</p>  <p><b>£3.7b</b></p>
<p><b>40,000</b></p>  <p>Industry employees</p>	<p>Standards committee representation</p>  <p><b>100+</b></p> <p>Ranked 2<sup>nd</sup> by BSI</p>	 <p><b>75%</b></p> <p>GAMBICA member industry representation</p>

**Our Sectors**

			
<p>Industrial Automation</p>	<p>Process Instrumentation &amp; Control</p>	<p>Test &amp; Measurement</p>	<p>Laboratory Technology</p>

**Our Activities**

			
<p>Market Data &amp; Analysis</p> <p>Market Data &amp; Trends, Economic Forecasts, Opinion Surveys</p>	<p>Technical &amp; Standards</p> <p>Shaping Standards, Tracking Regulation, Government Consultation</p>	<p>Representation</p> <p>Influencing Government Policy, Lobbying on behalf of our sector</p>	<p>Communication</p> <p>Press Articles, Conferences &amp; Exhibitions, Online &amp; Social Media</p>

# BENEFITS OF MEMBERSHIP

KNOWLEDGE	INFLUENCE	COMMUNITY
		
Regular briefings and updates on relevant industry issues, future opportunities and topical news	Influencing <b>Government policy</b> and lobbying on behalf of our sector, directly and as part of collaborative groups	Creating networks of members, associations, organisations, government, media, academia and other related stakeholders
Market data and trend reporting, economic forecasts and opinion surveys to help plan strategies and budgets	Developing <b>technical standards</b> that affect product compliance and acceptance worldwide	Development of International business through <b>exhibitions</b> , trade missions and promotional initiatives
Tracking and advising on the impact of changes in <b>standards and regulation</b> to stay informed	<b>Shaping opinion</b> through press campaigns, conferences, exhibitions, online and social media	<b>Member events</b> , seminars, consultations and training sessions across sectors and industries
Access to GAMBICA <b>Business Support Helpline</b> and Technical Consulting service	Promoting the benefits and breaking down barriers to <b>adoption of technology</b> in our customer sectors	Excellent meeting facilities and hot desking in London for members to use

# SPECIAL INTEREST GROUPS

**G**AMBICA has a number of groups which provide members with a network where common issues can be discussed. The groups are at a sectoral, product group or technical interest level.

- GAMBICA Board (by nomination only)
- Industrial Automation Council
- Process Instrumentation and Control Council
- Laboratory Technology Management Board
- Export
- Service managers
- Healthcare
- Variable Speed Drives Group
- Variable Speed drives Technical Committees
- Controlgear Group
- Controlgear Group Technical Committee
- Automation Products Group
- Interconnecting Technologies
- Uninterruptible Power Supplies
- Enclosures
- Rotating Electrical Machinery Group
- System Integrators
- Process Measurement, Control & Systems Group
- Flammable Atmospheres Group
- Environmental Regulatory Group
- Universities
- Machine Safety Components
- Electronic Positioning Sensors
- Encoders
- Electrical Installation Test Instruments Group

# THE COUNCILS

**G**AMBICA's Industrial Automation Council (IAC), Process Instrument & Control Council (PICC) and Laboratory Technology Management Committee (LMC) are arenas for the decision-makers in our member companies to exchange sector-specific opinions, discuss the current market trends, their drivers, and common interests – for example, Industry 4.0, future skills shortages, standardisation and the promotion of the sector.

The Councils and Committee members provide a vital steer for GAMBICA strategy at the sector level and, via the chairpersons, who are GAMBICA board members, at the association level.

The current chairpersons are:

- Process Control: David Ineson, Endress+Hauser
- Laboratory Technologies: David Smith, Specac
- Industrial Automation: Ian Clarke, Velocumen

If you would like to find out more about the IAC, PICC or LMC, please contact the relevant sector head. ■



# EURIS' SIX PRINCIPLES

The EURIS Task Force, representing UK suppliers of industrial products, has published a list of six principles that it regards as being essential to ensure the suppliers' competitiveness after Brexit.

Following the 2016 vote to leave the European Union, GAMBICA, with 12 other Trade Associations formed, the EURIS Taskforce. It is an advisory body for the potential impacts of the changing relationship between the UK and EU for the UK Government, manufacturers and the media. EURIS represents industrial product suppliers covered by the Single Market, representing sectors with a turnover of over £110 billion, and covers sectors responsible for more than 25% of total UK goods imports and exports.

As well as GAMBICA, EURIS members include: BEAMA (representing manufacturers of electrical infrastructure products and systems); the Engineering and Machinery Alliance; the Renewable Energy Association; the Catering Equipment Suppliers Association; the Federation of Environmental Trade Associations; the Manufacturing Technologies Association; the British Fluid Power Association; the British Pump Manufacturers Association; the Lighting Industry Association; the British Compressed Air Association; the British Plastics Federation; and the British Cables Association.

EURIS is looking to the future and is determined to ensure that manufacturers and suppliers in the UK are able to realise new growth potential through the Brexit process. To achieve this, we have developed the following six principles which will help to provide certainty in relation to regulations and standards, enabling UK manufacturers to continue to trade, innovate and grow.

EURIS is calling on the UK Government to acknowledge these principles and to ensure they are an integral part of the ongoing negotiations with the EU:

**1 EU-UK Regulatory Alignment** Adopting or mirroring EU technical product regulations for the long term is essential for product manufacturers to import and export from the EU post-Brexit. Any deviation has the potential to cause considerable confusion, uncertainties and costs. This may result in companies leaving the European markets, at significant economic cost to the UK.

**2 Post-Brexit Industry and Government Liaison** EURIS welcomes and fully supports the UK Government's proposal for a transition period. However, in addition to the proposed two-year period, it is essential that there is a long-term mechanism to confirm, and recommend for adoption, aspects of European legislation that specifically impact on the products covered by EURIS members, to ensure no new non-tariff barriers to UK-EU trade. EURIS suggests this mechanism is delivered through a permanent industry/Government organisation, or that it is part of sector deals. If this arrangement is not put in place, and EU regulatory product requirements cannot be mirrored effectively in UK structures, a five-year transition period is required to deal with regulation already in train and product cycles already underway.

**3 UK Market Surveillance Operations** EURIS is calling for the maintenance and enhancement of existing UK market surveillance and enforcement operations, in co-operation with the EU, to eliminate unsafe and non-compliant products from the market. There is a considerable risk that if there is any regulatory divergence on safety or environmental performance, the UK

could become a "dumping ground" for non-EU compliant product.

**4 Frictionless Borders** Frictionless trade across borders would allow both the product supply industry and those industries we supply parts to – such as the aerospace and automotive industries – to remain competitive in the modern world economy. The UK is the EU's biggest trading partner, so it is in the interest of both parties that we reach a positive agreement on customs arrangements. Frictionless borders would involve no significant additional tariffs, no greater administrative burdens and no delays at the border.

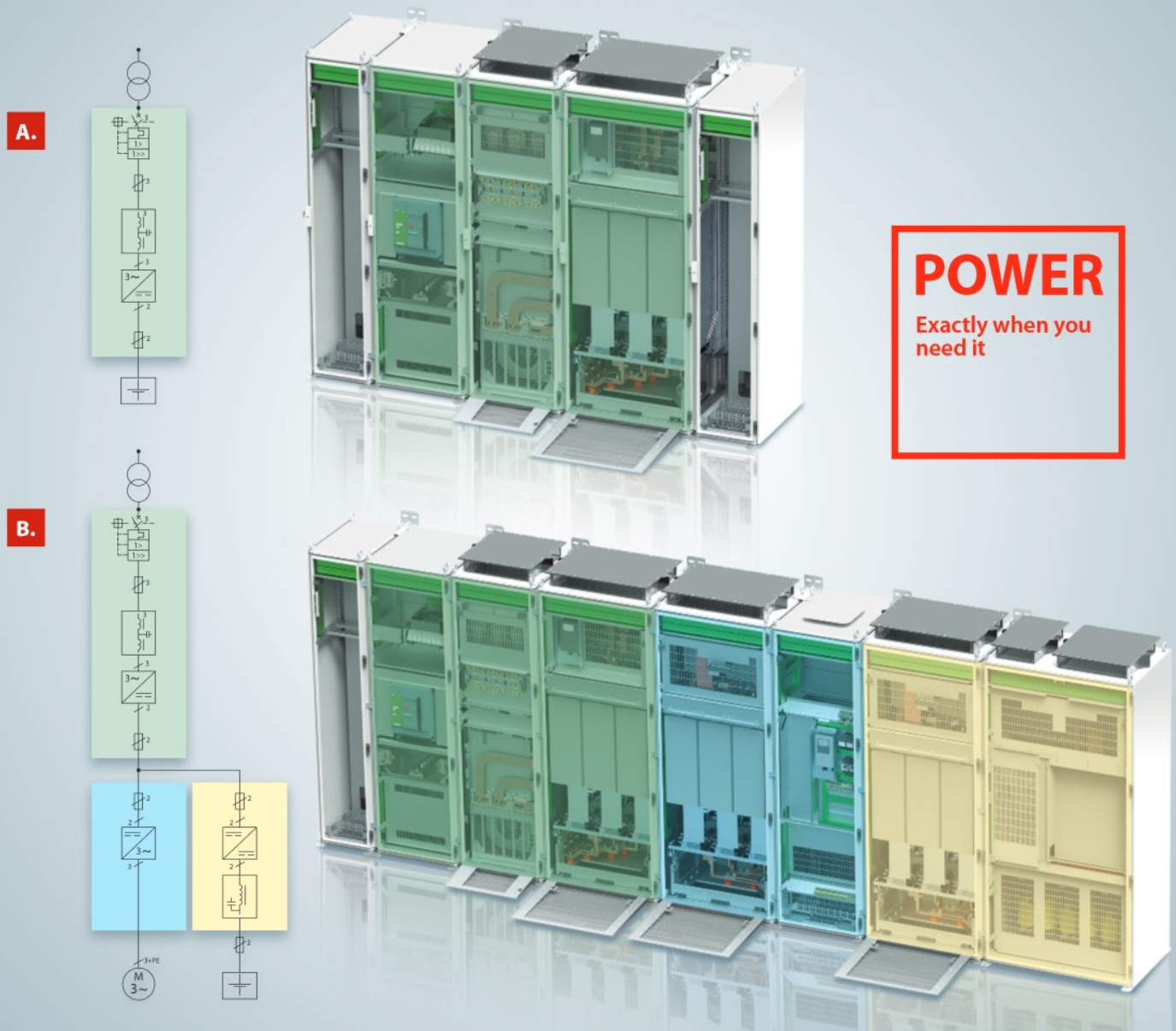
**5 Trade Negotiations Prioritised** Trade is the key driver of growth and prosperity and is crucial to both the future of the product supply sector, and the competitiveness of those sectors to which we supply, as our supply chain involves both imports and exports.

**6 Access to Skilled Labour** The UK is a hub for international talent and this must carry on post-Brexit with the UK continuing to attract the brightest and the best employees from around the world. Recruiting the finest talent possible, without bureaucracy and delays, will ensure that small and large businesses across the UK are able to continue to invest and grow.

**For further information on EURIS and the Six Principles please contact the EURIS Secretariat Harriet Dyball**  
[harriet@euristaskforce.org](mailto:harriet@euristaskforce.org)  
[www.euristaskforce.org](http://www.euristaskforce.org)



# Hybridization – perfectly balancing supply and demand



## Examples of hybrid configuration

### A. Energy storage directly connected to the AC grid using a grid converter.

> This improves efficiency, reduces the component count and overall size of the system.

### B. DC/DC converter connected between the DC link and the energy storage.

> This brings the load power/energy support close to the consumer, provides different storage voltage/technology adaptations, increases expandability and enables the battery stack to be replaced as needed.

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ENGINEERING  
TOMORROW

*Danfoss*

# HYBRIDISATION: A PROFITABLE DISRUPTIVE STRATEGY FOR ENERGY

A disruptive new technology – hybridisation – is bringing big changes and impressive benefits to electrical power systems, argues Alan Baird of Danfoss Drives.



Alan Baird

**B**usinesses are constantly looking for ways to reduce energy expenditure. One approach is to improve process efficiency, but a point is reached where further efficiency increases are no longer realistically possible. What then? Finding cheaper energy is one option, but the energy utilities are unlikely to oblige – at least not directly – so a more creative solution is needed. That solution is hybridisation.

Hybridisation is characterised by a power system that has access to two or more independent sources of energy. The word “independent” is important – a power system that can be fed from either of two utility substations wouldn’t qualify, because it has two connections to the same energy source – the national grid. However, a power system that can source power from the grid and from, say, a solar panel installation, is definitely a hybrid system.

Adding a renewable energy source to a power system will probably deliver savings but, if energy storage is also added, it’s possible to save even more money and to improve versatility.

Typically, hybrid power solutions are used in “behind the meter” applications, such as peak shaving. Power systems must be designed to supply the maximum load safely, but this maximum demand will invariably be intermittent. This means the system’s power transformers are working below full capacity most of the time. Now consider a factory with a hybrid power system incorporating energy storage.

The power transformers can be rated for the average load, with the battery making up the difference during periods of maximum load. This is peak shaving.

In addition, many commercial supplies are priced on “maximum demand”, i.e. the utility charges for energy consumed and also for the maximum load the user puts on the supply system. Peak shaving enables energy users to reduce their maximum demand and the associated charge by supplying some of their peak energy needs from their batteries.

Another option is storing energy when prices are low and releasing it when they are high, which reduces energy bills significantly. Some hybrid systems can also generate reactive power on demand, which improves power factor, saving both energy and money. In addition, the batteries can power the plant if the grid supply fails, potentially eliminating the need for a separate UPS installation. Hybrid power systems can even feed energy from the batteries back into the grid. The utility pays for this, offsetting energy bills.

The technology for hybrid power systems is readily available. There have been big developments in batteries, with lithium-ion technology being a popular choice, although users with longer time period requirements may benefit from alternatives such as flow batteries.

Batteries produce DC power, whereas commercial power systems usually need AC. The solution is to use

standard inverters. These are more familiar as variable-speed drives that take AC power at supply frequency, convert it to DC (the DC link) and then convert it back to AC. The DC link can alternatively be fed from a battery and the inverter will convert the DC to AC at a frequency accurately matched to the grid. Inverters in hybrid power systems can also take power from the grid to top up the batteries.

Danfoss inverters for hybrid systems use the same hardware as variable-speed drives, and this commonality means hybrid applications benefit from products proven in thousands of VSD applications.

Considerable expertise is necessary to implement efficient hybrid power systems, so it’s advisable to choose a supplier with proven expertise. Danfoss is such a supplier and provides solutions complying with international grid codes. These are already delivering big savings in hundreds of applications.

Disruptive technologies receive much attention, but many applications to which this epithet is applied are unworthy of the title. An exception is hybridisation. Hybrid power systems are a radical development: they deliver large cost savings while reducing environmental impact. So great are their benefits that it’s likely hybrid power systems will soon predominate. But there’s no need to wait! You can benefit from hybridisation right now – start today by contacting a leading inverter expert with proven hybrid expertise! ■

# SUPPRESS INTERFERENCE AND ENSURE YOUR DRIVES WORK SMOOTHLY, SAFELY AND IN HARMONY

To ensure the stability and safety of drive assemblies, OEMs and machine-builders can choose from a variety of mains- or motor-side suppression accessories – or combinations of the two – to ensure that their drives comply with the EMC requirements of the application, says Mark Checkley of KEB Automation.



Mark Checkley

In many industrial environments, ensuring the stability of drive controllers is sometimes overlooked. However, an EMC-compliant (electromagnetic compatibility) drive assembly with an efficient control cabinet and suppression system is the basis for ensuring the safe and reliable operation of machines. It can also extend the lives of certain components.

Manufacturers and operators are required to implement the installed drive systems so as to achieve electrical compliance with the limits (for emissions) and requirements (for fault-free operation) set out in the relevant European and International standards and regulations. Utilising some components can lead to additional advantages besides compliance.

When selecting a drive, it is sensible to check what range of accessories the drives supplier can offer. Whilst some of these accessories can be sourced from other third-party suppliers, it is often better to deal with a supplier that can provide everything from a single source, so the items are optimised to suit your drives (or even designed in-house for your drives) and therefore more likely to meet the application requirements.

The operation of variable-speed drives with intermediate voltage circuits can put stress on the mains and motor, which can be optimised using additional measures, depending on the place of use and the type of application. An EMC-compliant drives assembly may therefore include accessories and

interference suppression components for the mains- and motor-related optimisation of operating conditions. The most common suppression components and their functions are:

## Mains suppression

**Mains chokes** optimise the harmonics to the mains power supply that result from the pulse-shaped charging of uncontrolled rectifiers and reduce the effective input current. This decrease in stress has the direct effect of significantly increasing the service life of the link voltage capacitors in inverters and servodrives, as well as reducing the stress on the input rectifier. By smoothing the input current draw, the lifetime of the drive and its components are enhanced, particularly at constant high utilisation. For mains chokes, ensure there is sufficient installation space to account for the higher heat emissions and strong magnetic field.

**Mains EMC/Harmonics filters** reduce the cable-fed emission to the required limits of IEC 61800-3-C1/C2. Other variants may offer low leakage currents or the operation of special mains networks. Harmonics filters reduce the low-frequency mains distortion on rectifier supplied devices by a further 8-15%. They allow easy integration into a switchgear layout.

## Motor-side accessories

**Motor chokes** provide a cost-effective option for reducing the voltage rise rate (dv/dt) to avoid premature ageing of the coil insulation in AC motors, particularly on high-speed applications. They

increase total inductance at output and reduce current ripples, as well as reducing the peak value of the current and stress on IGBTs in inverters. Motor chokes are also suitable for applications with long motor cables (>15m and up to 50m).

**Sinusoidal filters** are low-pass filters that filter out the switching frequency from the PWM (pulse width modulation) output signal of the inverter. Sinusoidal voltage with a small ripple occurs at the output, which results in a sinusoidal motor current. This is why the use of sinusoidal filters at the output is not associated with the supplementary losses in the motor's stator and rotor, which otherwise occur with inverter use.

## Mains-motor combinations

Some suppliers offer combinations of mains-side and motor-side accessories that can be tailored more closely to suit the specific needs of the machine or robot. Combi-filters (EMC/output choke), for example, are space-saving combinations that provide the advantages of both, with the addition of reduced wiring, and adapt and optimise the drive controller consistently.

**I/O filters** integrate the functions of the mains-side HF filter and motor-side dv/dt filter in a compact enclosure. Part of the input filter that is configured with high damping at minimal leakage current, reduces conducted interference to limit value in compliance with EN 61800-3. These can be incorporated inside some drives, saving space. Low-leakage versions are also available. ■ [www.keb.co.uk](http://www.keb.co.uk)

# MEETING THE CHALLENGES OF SMART MANUFACTURING

Implementing smart manufacturing systems can bring greater efficiencies and flexibility to any production process. Mitsubishi Electric's Chris Evans contends that is also a significant step towards "futureproofing" a production enterprise.

A "forward thinking" mindset is essential when implementing smart manufacturing projects where intelligent machines, systems and networks are capable of independently exchanging and responding to information to manage industrial production processes.

A smart manufacturing project should incorporate a holistic view of the enterprise, from customer demand and order processing, through control of raw materials and ingredients, to flexible and efficient plant production, while minimising waste, energy usage and downtime. Achieving this goal may need a staged approach and will often be achieved by taking small initial steps. Understanding the manufacturing plant's goals and their current "pinch points" is essential to finding quick wins and building confidence in the smart manufacturing process.

Technology exists today to implement

BELOW: Smart manufacturing can deliver many potential benefits.

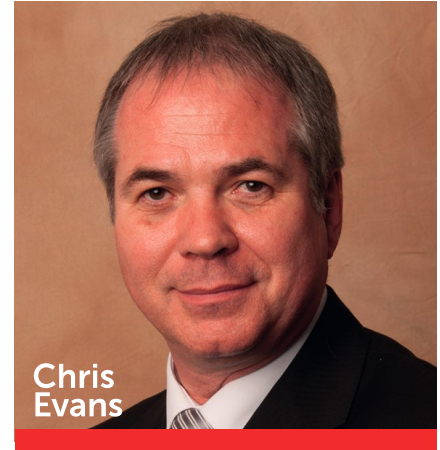


smart manufacturing and it would be perfectly feasible to design new manufacturing plants or production facilities from the outset in line with a smart manufacturing concept. However, in many cases, the reality is not a new plant but an existing plant that will need to be upgraded to meet the requirements and reap the benefits of implementing smart manufacturing.

"Smart" in its simplest form is about gathering data from the manufacturing process, turning that data into information, and then acting on that information. What is needed is "intelligent data" from the plant to make decisions that improve productivity and efficiency while minimising waste, energy usage and downtime. Intelligent data has to come from the "sharp end" of the process. Sensor and actuator technologies allow these devices to deliver self-determination and advanced error-checking, as well as the usual information for both control, production analysis and preventative maintenance.

Traditionally a production plant may have consisted of "islands of automation" but to maximise the data-gathering potential, existing or new infrastructures must be used to create an architecture for data collection and management. It is possible to overlay a "data-gathering layer" on top of the existing automation control layer to communicate with, and extract data from, these disparate systems. It is helpful therefore to ensure that the automation hardware is compatible with a flexible open network strategy that can interface with many different network protocols.

When plant assets are controlled by automation controllers such as PLCs, much of the data vital to deliver the smart manufacturing concept often already exists, even if this data is not currently being transferred to the higher level systems. The new data-gathering



Chris Evans

layer can then be used to marshal this vital production and maintenance data and pass it on to higher-level systems for analysis and decision-making. Productivity and efficiency improvements come from knowing exactly how the plant is performing and delivering intelligent plant data via a reliable infrastructure (coupled with the convergence of business-level systems with the production facility).

This data-gathering layer is now referred to as the "edge computing" layer and advances in technology in this area will provide the facility to perform data analysis and deploy artificial intelligence (AI) to rationalise the data being collected from the plant. This will minimise the data that needs to be transferred to the higher-level systems which can be a costly exercise to process at that level.

The investment required to deliver a smart manufacturing plant will depend on the current infrastructure and age of the automation equipment, but a survey of what is already on plant may lead to some "low-hanging fruit" on the road to a smart manufacturing end-goal.

Once achieved, smart manufacturing affords many benefits including the flexibility to react to customer demand, maximising plant productivity by efficient scheduling, achieving minimum downtime when changing from one product to another, and from preventative maintenance – all of which should lead to greater profitability. ■

# WHERE IS THE NEXT GENERATION OF BRIGHT, YOUNG ENGINEERS?

We need to be more creative in the way we tackle the skills shortage, argues Darren Spearing, product marketing manager at Routeco.



**Darren Spearing**

Engineering is such an exciting field to work in, but those of us doing it already are scratching our heads as to where all the bright, young prospects are. Why is the queue of apprentices and fledgling career applicants looking to work in our wonderful, innovative companies not out the front door and halfway up the road?

STEM experts have been warning of a growing skills shortage for quite a while now. Has it fallen on deaf ears? They continue to highlight issues with the supply of qualified candidates in science, technology, engineering and mathematics. STEM roles are predicted to double in the next 10 years and the next generation – the young men and women who will take our businesses to the next level – well, they are pursuing careers in other areas.

It's as simple as that.

We have to ask ourselves whether this generation really, truly understands what engineering is, in its fullest sense. Have we packaged it wrong? Are we making it look and sound hard to understand or, worse still, boring?

There is so much to be excited about! Let's put it this way – for every engineering role that's created, there is a multiplier effect that benefits local suppliers providing related goods and services. Engineering is great for the local economy and no generation has ever been more aware of the environment and the need to support the local community over globalisation.

We need to be more in touch with the way young people consume information, and creative in the way we package engineering and communicate it to them. We need to engage.

At Routeco, we have been working on new ways to engage by taking high-level subjects (IIoT, Industry 4.0/IR 4.0, Connected Components) and creating practical activities that young engineers can be excited by. Since the changes with year 10 pupils being able to leave school and start pursuing a career, schools, academies, colleges and the new UTCs (University Technical Colleges) are desperate to partner with established companies. There are plenty of opportunities to work directly with young people, from 14 years of age, and to attract them to engineering career paths.

The most important job we have is to inspire the next generation of engineers, not to teach them. Visual and practical engagement is the key. We have to think more about how Generation Z engineers, born after 1995, seek and consume information. It

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has become a short attention span, high-impact age of image and video consumption, primarily through social media. It's time for us to polarise on a different mindset and one we've been struggling to relate to: "Don't tell me, show me."

So, what can we do? At Routeco, we've found robotic demonstrations and application videos to be highly effective at getting this audience's attention and educating them on the length and breadth of what we really mean when we use the term "engineering". Many young people still think it means nuts, bolts and grease. That's the bottom line. We often show videos of theme park rides, car manufacturing and food production – popular content for TV shows – and this seems to spark their interest because it's both relatable and genuinely interesting.

Another strategy we find to be effective is our real-world stories. Anyone can peddle the "dream" of a career in engineering, but we ask our own apprentices to share their experiences and their journey into the engineering world. It makes things real and obtainable, something a glossy brochure or Web site will struggle to achieve. We invite young engineers to see for themselves what's possible and imagine: "If that person can do it, then so can I".

Engineering has so much to offer the next generation; in fact, it's going to be

a critical part of their future. With the growth of automation and process control, some 80% of jobs are predicted to be performed by robots within the next 20 years. It really is the field to be working in for a bright future.

So, what's our point here? It's a simple one: change your course and start doing something about it, along with us. This is our responsibility. Don't wait for a shortage because, by that time, it's going to be too late to find quick solutions to the lack of available engineers. That can and will have a drastic impact on our businesses.

Start being more proactive: engage with your local schools, colleges, academies and look for a suitable UTC to partner with. Did you know that the UTCs work in tandem with organisations to prepare young people, from 14 years old, to be trained and job-ready (not just work-ready) by the time they're 18? The opportunities are out there in abundance.

IR 4.0 is here. It's time for us to start doing things a little differently around here. ■

BELOW: We need to inspire the next generation of engineers



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# ADAPTIVE MACHINES CATER TO NEEDS OF NEW-GENERATION CONSUMERS

Product cycles are becoming shorter and consumers more exacting in their demands. For machine-builders, this means a new type of machine is required – the adaptive machine. As Alan Conn, managing director of B&R Industrial Automation UK & Ireland, explains, this is a machine that can change with requirements and alter its output during production, aiming for the ultimate goal in customisation – a batch size of just one unit.

“Any colour you want, so long as it’s black” is an attitude that might have made sense back in Henry Ford’s days, but not any more. Today’s customers have other expectations, seeking value, uniqueness or instant gratification. This has an impact on machine-builders, whose designs need to evolve to keep up with demands for flexibility, cost reduction and time-to-market.

Automation used to result in installations that were clunky and inflexible. Not so any more. Today’s systems are agile and adaptable, enabling manufacturers to aim for the ultimate goal in customisation – a batch size of just one. While the ultimate goal may not yet be quite achievable, we are well on the way. Today we have adaptable machines that feature independently controlled modules with multidirectional movement, tight synchronisation with other robotic devices, and exceptional flexibility.

To this you can add the versatile transport track systems that form the backbone of the adaptive machine, moving items vertically as well as horizontally, synchronising different tracks with varying speeds, and working on products while in transit.

This technology enables the type of production that a new generation of consumers demand – a generation that expects to get exactly what they want, when they want it.

## Customised sizing

One of the companies responding to this trend is Tavail, a Spanish manufacturer of packaging machinery. The company has designed a case-packer that can make up, fill and close four different-sized cases on demand, at up to 20 cases per minute, and can

change case sizes in just four seconds. This enables mass-customisation without reducing productivity. With major shipping companies now charging by volume as well as by weight, solutions such as this one are well suited to e-commerce.

Batch size one – as well as very small batch sizes – allows shipping to consumers directly from the manufacturing line, thus cutting out the middle man. This is an interesting development to many manufacturers, in an era where the balance of power has shifted to the sales channel and production capacity has become a commodity. Here is an opportunity for manufacturers to re-establish a direct link to their end-users.

Smaller batch sizes also result in savings, such as reduced costs for inventory of finished goods and for raw materials, fewer distribution centres, less need for servicing different sales channels, and no unsold goods of which to dispose.

## Emerging technology

So the benefits of batch size one are very tangible. What has been lacking, so far, is the technology to service this need. To meet the expectations of a new generation of consumers in a cost-effective manner, a new type of factory is needed – a smart factory.

In the smart factory, changeovers become a thing of the past. Instead, the opportunity to change both product and package comes with every cycle.

To improve productivity further, accumulation of goods is replaced by synchronisation of flows. Where dissimilar products have different process times, parallel processing in different streams balances the production time to meet the final target.



## Individual labelling

One example of a new generation of packaging machinery now entering the marketplace is the Gen4 labelling system from the Italian manufacturer, Makro Labelling. This takes servo control of bottles to a new level. Two shuttles on two tracks are synchronised to control container movement, while a third shuttle uses linear motion to turn the container label for application. With multiple label applications, different labels can be applied in line, whether for different bottle sizes or shapes, or different products or flavours for batch size one.

As the lifecycle of consumer products and packaging keeps getting shorter, the number of items in the product range keeps growing. Given the 15–20 year service life of industrial machinery, it is not possible to anticipate all of the changes that will occur – especially the disruptive ones.

The adaptive machine will support rapid changeover and allow reconfiguration with different production modules using the same platform. It is easy to adapt to different sizes and formats. It will also adapt to



radical and unforeseen developments, such as the move from cartons to plastic pouches in the packaging industry.

### More profitable

Batch sizes may be shrinking, but variables such as lead times, volume and throughput, remain critical. The challenge is to produce the goods cost-effectively. In the long run, adaptive machinery does not cost any more than traditional machinery. Improvements in availability, performance and quality ensure effectiveness over time. The resulting reduction of indirect costs means higher profitability in the long term.

New-generation conveyor systems use tracks with variable pitch, enabling products to be moved individually. The movements can be synchronised to prevent bottlenecks and eliminate the need for accumulation buffers.

The products are moved on shuttles that can be synchronised with other shuttles moving in a different flow. A process that takes four seconds, for instance, can be synchronised with a two-second process on two shuttles. A well planned variable-pitch operation

optimises production efficiency.

### Improved productivity

The adaptive machine can increase line productivity – not just by 5 or 10%, but radically. With traditional fixed-indexing product transport, productivity is limited by the slowest station. The adaptive machine solves this by having multiple installations of the slow station. The increased productivity can be substantial and is determined by the difference in processing time between the fastest and slowest stations.

With the latest generation of track systems, product flows merge and divide as required. Items can be sorted on an individual basis. Defective products can be easily put to one side. Equipment availability increases along with overall quality.

### Better reliability

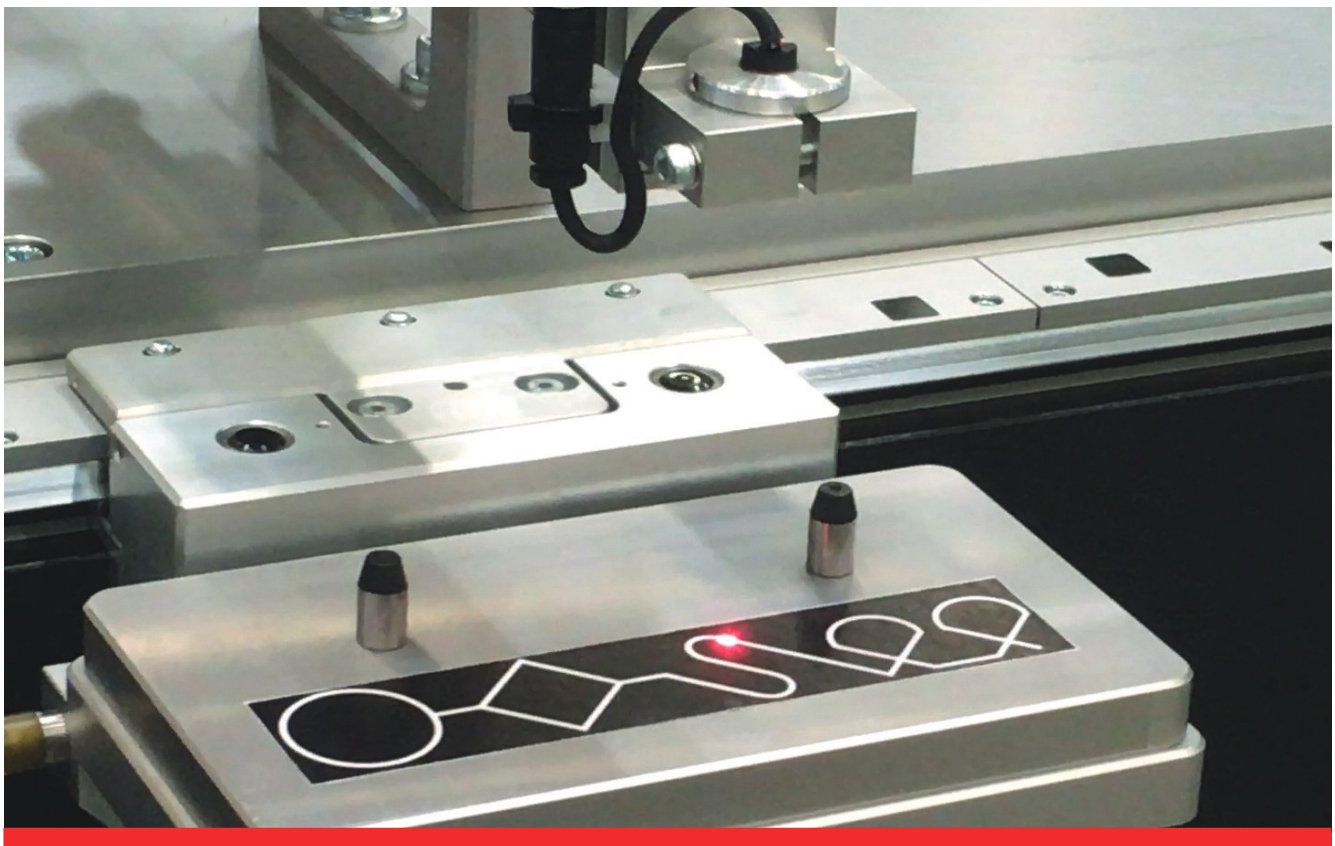
If two or more stations perform the same operation, the redundancy can be used to give the adaptive machine an exceptional level of fault tolerance. Traditionally, a fault with one processing station would result in faulty products needing to be sorted out further down the line. The cost for the products as well as their packaging

was lost. Using an adaptive machine, the faulty station is simply disabled with a tap on an HMI screen. The transport system stops sending products there and production continues with the usual level of quality, but with a slightly reduced output rate.

When working in an expanding market, the installed capacity will eventually reach its limit. This used to mean that a manufacturer had a choice of either adding machinery, or upgrading with more productive equipment. The adaptive machine offers another option – scalable machine architecture. By adding new track segments and additional processing stations, the installed capacity can be upgraded easily with minimum investment.

The adaptive machine gives manufacturers the tools they need to service a new generation, where consumers expect to be treated as individuals. Batch size one meets the needs of this generation. ■

BELOW: The latest track systems can sort items individually, and merge and divide product flows.



# INDUSTRIAL SOFTWARE DEVELOPMENT - A MANAGED SCIENCE

Jan Hemper, technical director of InControl Systems, discusses the challenges of managing the development of software for OEM machines and specialist equipment

One of the biggest challenges facing OEMs of machinery and specialist equipment is the reliance on, and management of, their control system developers – especially the programmers of PLC code or developers of other types of software.

The managers who face the challenge of specifying the machine operation and performance, and of finding the resource to perform the PLC code development, are rarely PLC programmers themselves. In all but the biggest companies, the management team understands the base machine technology, the markets and the processes, yet relies on either a single internal PLC programmer, or an external contractor. Imagine the risks of being reliant on one person and not

BELOW: PLC code development should be included in a business' strategic priorities.



Jan Hemper

knowing if a replacement programmer will have access to the source code, the tools, the files and the often-forgotten supporting documentation – if it ever existed.

## Risk and reliance

In our experience, many OEM companies have a small number of expert programmers, who are either employed or sub-contracted. And if you rely on just one or two people, how do you manage to deliver new machine variants or debug recently delivered machines, if your one expert is on vacation or sick leave?

Other considerations are needed to ensure that the programming of your machines and their functionality are future-proofed and de-risked. You may also need to source additional PLC programmers who will either be part of their own payroll or a sub-contracted service that can be relied upon and potentially switched to a different sub-contractor if the first one cannot meet your needs.

Managing the development of your PLC code might seem like a black art that you will never understand, but the implications of getting it wrong are enormous. For example, how much would it cost your business if you couldn't ship any machines or equipment for eight weeks while the



PLC code was rewritten or ported to a new platform? Or how much business or market share would you lose if your competitors engineered their machines to connect seamlessly into the world of Industry 4.0 and cloud-based analytics?

### Business contingency and strategic planning

Often your business strategic priorities will not go down to the PLC programming level, but I would suggest that they should. The benefits of well planned, specified, structured and written code will not only produce a reliable and high-performing machine, but it could also make your business strong and profitable as a result of being ahead of the competition.

On the flip side, poorly developed code or inadequate resourcing can put a company at risk, either from production delays while code is written or rewritten, or may place a company at severe competitive disadvantage while other machine vendors in your industry steal your market share and customers.

As a minimum, I'd recommend that machine-builders should take references from their past projects and use recruiters with specialist knowledge in the automation and engineering sectors. If using a contractor, try to find one with expertise across different platforms and industry sectors, and if it is a single person contractor, you'll need to plan for back-up for when they are not available.

Manage your engineers and contractors so that you get access to, and secure storage of and source code for, work which will need to be in an editable format. Remembering that good software developers will always deliver well-documented code, but make sure you get it agreed for new projects.

And finally, for best practice, ask for independent advice on how to specify modular code. This will ensure you have maintainable and future-proofed software development, in turn making any future machine variants easier to deliver.

There are benefits and challenges to working with employed software developers, as there are for working with contractors. In an ideal world, you have an engineering manager who understands fully the management of code development, but few companies can afford that luxury. By taking care of the management and planning of machine automation code development, you can move away from having risks that you can't be expected to understand, to making your software development reliable, secure and a core strength of your business, reducing delivery times, cutting costs and putting you ahead of the competition. ■

*Jan Hemper has 22 years of software engineering and industrial automation experience and has been technical director of InControl Systems for 20 years. He has also written a White Paper on this subject, which is available from [info@incontrol.co.uk](mailto:info@incontrol.co.uk)*

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# GRASPING THE OPPORTUNITIES OF INDUSTRY 4.0

Industry 4.0 promises to transform the way we manufacture and distribute goods and services. No longer simply a concept, it is very much of the “here and now”, and the opportunities for growth and productivity that it affords to manufacturers of all shapes and sizes, are ripe for the taking, as Lenze’s Neil Beaumont explains.

Industry 4.0, the Industrial Internet of Things (IIoT), big data, the cloud – these are terms that would have appeared alien to industrial automation specialists a decade ago. But the digital transformation of manufacturing industry is now in full swing, and the innovations that these terms represent are already bringing rewards for those forward-thinking enterprises that have embraced them.

Manufacturing industry faces fundamental changes in the way it produces goods, how it engages with its supply chain, and serves its customer base – and while Industry 4.0 may be at the heart of this transformation, questions about how it may be implemented, who best to consult on implementation, what the costs are in terms of investment and cultural change – must all be addressed at some stage.

Let’s consider those first two questions regarding implementation: the how and the who. Who best to approach for guidance on how to implement the Industry 4.0 paradigm throughout an enterprise? The more obvious choices are those suppliers of basic and advanced production hardware and their associated systems engineering that manufacturers rely upon so heavily – the machine-builders and systems integrators.

Automation and networking have been fundamental aspects of manufacturing for many decades, and it is the machine-builders and SIs that have pushed the technologies forward and who are now embracing the concept of Industry 4.0 and all its attendant technologies. Modern production machinery must offer a high degree of compatibility with other elements of the production system; it must also be

scalable and modular in its configuration in order to adapt rapidly to changing production needs.

Modern Industry 4.0 automation solutions are not merely restricted to the networking of modular machines on the shop floor. Digital transformation of the enterprise is inextricably linked to the interconnectivity and interoperability of IIoT-enabled devices and the almost infinite capabilities of cloud computing whereby data from machines and production systems are collected in the cloud, analysed there, and then linked to other enterprise information systems on demand. The huge amount of manufacturing-pertinent data and computing power available to production machinery from the cloud will ultimately transform machines from standard controlled entities to intelligent, independent systems, capable of making decisions and acting upon them without human intervention.

Connectivity to the cloud will become a standard feature of field-level devices over the coming years, rather like the proliferation of fieldbus communications between devices on the shop floor developed in decades past. Standardised protocols will become important additions to any automation portfolio, guaranteeing a certain level of future-proofing.

Of critical importance to all this, of course, is security. The interconnectivity and integrated processes that define Industry 4.0 are worlds away from the isolated control systems of the past. When control systems are directly connected to the business IT environment, with free flow of data via the cloud throughout the enterprise and beyond into the outside world, there is the potential for every point on those



networks to be vulnerable to cyber-attack. A determined cyber-attack could see the theft of intellectual property, data corruption, production losses, damage to capital equipment, reputation impact, injury to shop floor personnel, or even loss of life.

In terms of protection, a security policy should adopt a combination of technologies and approaches which might include strategies for isolating very sensitive areas from the network altogether; making use of industry-standard encryption technologies; making multiple firewall implementations, using artificial intelligence-based systems that continuously monitor network traffic to look for suspicious activity, and frequent testing of attack scenarios to help train and bolster awareness among staff.

Security is a complex and continually changing challenge, but by adopting modern devices, platforms and tools, and by taking a systematic approach, machine-builders and equipment owners can balance the costs and risks and, by doing so, help to promote the true benefits of enterprise digitalisation and the brave new world of Industry 4.0. ■

*For more information, contact [marketing.uk@lenze.com](mailto:marketing.uk@lenze.com) at Lenze, Fraser Road, Priory Business Park, Bedford MK44 3WH. Tel: 01234 753200*

# MAINTAINING CLIMATE CONTROLS IS NO FALSE ECONOMY... IT'S THE KEY TO EFFICIENCY

There is a tendency for enclosure users to take the cooling systems in their cabinets for granted, and to devote minimal resources to maintaining these systems. Karl Lycett, Rittal's product manager for climate control, argues that this could be a costly mistake.

**£** 480,000... is a lot of money! But that is what it costs one of the UK's largest automotive manufacturers **per hour** when they experience downtime on their paint plant.

Your overheads may not be as substantial, but that doesn't take away from the fact that the old adage is true – time is money.

Regardless of your industry, production downtime is a crucial statistic to monitor because of the direct impact it can have on your bottom line. Downtime equals increased spares/maintenance costs, taken directly from your profit, which could have been invested to meet more pertinent business objectives, purchasing new machinery and so on.

When I talk to customers regarding their attitude towards climate control maintenance, this tends to fall by the wayside, and there seem to be some key drivers for this thought process:

***"I will just fix a problem when it occurs..."***

In the past, reactive maintenance was seen as acceptable for most businesses. However times have changed.

Operational objectives are now becoming "increased throughput", "cost efficiency" and "continuous improvement". Potential roadblocks to output targets need to be nipped in the bud and nobody wants to be the one in the meeting explaining why targets were not met!

The implementation of a semi-regular maintenance schedule doesn't have to be time-consuming. Even something as simple as a weekly visual check of cooling equipment filter mats or system alarms can alert you to call in the

experts, who can then perform a more detailed review for you.

***"My equipment is currently operating and I haven't serviced it in months/years..."***

The problem may be "out of sight, out of mind" but the longer your cooling equipment is left unchecked, the higher the risk.

If a fan is in a dusty environment and the filter becomes clogged, this will reduce its effectiveness to cool the electrical equipment due to a reduced level of air throughput. This can increase the enclosure's internal temperature. As a rule of thumb, for every 10°C you increase your internal temperature, you halve the life of the equipment, and increase the likelihood of an unexpected failure.

***"We just open the enclosure door for a while..."***

This is treating the symptoms rather than the illness. If you are having to resort to a tactic such as using large fans to blow ambient air into an enclosure, you could be doing more harm than good. Not to mention that this is massively dangerous from a health and safety standpoint.

An enclosure's purpose is to create an environment in which equipment is protected from ambient contaminants. Having the door open allows dirty air to be pulled into the enclosure. This will then gather in switchgear and can cause short-circuits or block on-board fans, which will result in damage to componentry, reduced lives and critical component failures.

If this course of action is required, it can point to the fact that the cooling equipment currently used is not



adequate for the installation, or it requires some level of maintenance to bring it back into working order.

***"I don't have the manpower/we have a company who does that work for us..."***

Many companies tell me that they outsource their servicing to third parties, however I tend to question what they are checking, given that I have been called onto site because an enclosure is overheating!

On one occasion, I asked the customer to speak to their service provider to understand what checks were being undertaken, because their cooling units were in quite a state of disrepair. It became clear after a short discussion that they serviced air-conditioning in the offices and didn't even look in the factory...

Obviously this is not the case for all service providers, however climate control equipment is becoming increasingly efficient, and new cutting-edge technologies are being launched every year. The only guarantee of the highest level of service will come from engineers who have been trained by the manufacturers about the technology.

Take the introductory example again and turn the spotlight onto your business. Everyone has budgets and targets to hit, so ask yourself, can you afford **not** to have correct maintenance in place? ■

# 4IR IS EXPANDING HUMAN POSSIBILITY

The digital transformation of our factories is not just a way of improving productivity and flexibility. Mark Bottomley, Rockwell Automation's regional sales director, North, for the EMEA region, argues that it should also be a tool for helping people to do what they do best.

**W**e are in an era of great possibility. An era with huge potential for transformational change, not just within industry itself – and how things are made or processes are managed – but genuine transformation that will reach into every aspect of our lives.

Industry 4.0, or the Fourth Industrial Revolution (4IR), places automation at the heart of the change as it enables digitisation, unlocks the power of data to create greater efficiencies, and the power of computing to break new ground. The future, as we are all becoming aware, is one of driverless vehicles, automated self-checkouts at the supermarket, and soon, software doctors and digital dentists.

## Misleading paradigm

The ONS has estimated that 7.4% of UK jobs are at a high risk of automation. Such statistics and related headlines set up a jobs vs automation paradigm which can be misleading. In fact, the whole issue can, at times, be quite perplexing.

Why, for example, is the UK's poor productivity (output per worker, per hour) considered such a threat to our continued economic prosperity? Automation is vital to improving productivity, so surely it should be welcomed? But by welcoming automation, are we not bringing forward a jobs crisis? What will the people who are automated out of jobs do?

This paradox belies the nub of the issue. Human possibility.

First, let's go back to those ONS statistics. They state that, as of 2017 – the most recent data available – 7.4%

of jobs were at high risk of automation. This figure is down from 8.1% in 2011. Yes, down.

It is not down, I would suggest, because the potential of automation was overstated back in 2011 – in fact, the number of jobs classified as at a low- and medium-risk of automation have increased over the same period. This suggests that automation is becoming more capable than expected, not less capable. It is down because people are moving up the value chain. Many jobs, it might be supposed, have already been "lost" to automation, and the workers have taken other jobs – usually ones that pay more and involve better working conditions.

A useful way to consider automation is that rather than taking away jobs, it removes repetitive tasks. Since jobs are usually made up of many tasks, it frees people to undertake different roles, or to focus time and energy on more productive activities.

This leads us back to the productivity point. By automating, the output value per person is improved. This is not necessarily because there are fewer people but, more often, because there is more output. That observation is supported by the fact that in advanced economies with higher levels of automation (think Germany or Japan), productivity is higher. Those highly automated industrial economies also employ more people. Put simply, there are more jobs available in highly automated industry, as well as more output per person.

The Fourth Industrial Revolution is not something that the UK can simply opt out of in the hope that it can protect



Mark Bottomley

jobs from automation. Nor can it rely on relatively low-cost labour as an excuse to under-invest in automation – that is foolhardy short-termism. Indeed, in many sectors, the UK is taking advantage of its enviable position as a country with near-perfect ingredients to be a world leader in the new era. If the UK did not engage in 4IR, its industrial base would soon become uncompetitive, and the resultant loss of jobs and impact on the economy would be vast – some might say devastating. Lest this cause unnecessary worry, I can assure you that the UK is indeed adopting 4IR technologies and that fears of the demise of industry in the UK are premature.

Having said that, we simply must tackle the productivity issue, or the UK will be held back from taking the leading global position it is capable of. It will miss out on a huge opportunity. Automation holds the key to unlocking our 4IR future – it is the low-hanging fruit that can catapult UK industry into a position of global leadership. It cannot, however, do it alone. The human factor is central to making a success of automation and of 4IR. Technology alone cannot do it.

## Expanding human possibility

What is needed is a concerted effort within industry, government and education to help create the workforce that we need for the future. We need

more young people studying the STEM subjects that will equip them for a fulfilling career in industry – the same skills that will also help to protect their working futures from robots and computers, whatever career path they follow. Let's not forget that automation is not only an industrial phenomenon. For the UK, in particular, if this new generation can be representative of the population by gender and background, it will have a further advantage in the future. It's known and accepted (as well as being common sense) that diverse workforces make better decisions – up to 87% of the time, according to Forbes.

But we can't wait for a new generation, even if we are able to inspire them. And it bears mentioning that despite efforts and useful projects to help encourage the uptake of STEM subjects, we've not yet made much progress in that regard. No, there's a clear and present need within industry right now. What we at Rockwell Automation observe is that a lack of available skills is already a drag on the adoption of new technologies here in the UK.

Which brings me to another little paradox. In the age of digital transformation, the most important asset of all is the human one.

We live our brand promise at Rockwell Automation – to use technology to help expand human possibility. As the world's largest company dedicated to industrial automation, at a global level, that human possibility refers to the great challenges of our times – clean energy, global warming, finite resources, and increasing populations.

But, importantly, we see digital transformation technology and automation as being an enabler to the people of industry. A tool for the workforce – the human element – that can be used to overcome those challenges. We see it as a tool for human creativity and endeavour. A tool to help people do what they do best: to find problems, analyse them, and create solutions that resolve them. All of this may sound grandiose, but it is applicable at every level.

For UK industry to resolve our

productivity puzzle, companies of all sizes must invest in their workforces. Lifelong learning must become the norm, rather than the exception. We must unlock the potential not only of the next generation, but of all of us working in industry right now. Supporting workers in career progression, providing training for them to move up the value chain; these are the approaches that can help to bridge the skills gap. And no-one knows the requirements of a company, its values, principles, challenges and solutions better than its own best asset – its people.

Leadership in a time of rapid technological evolution is not just a case of overcoming the technical challenges of implementing new system. It's about unlocking the potential of people. It's about providing the tools for every person to grow within the business, to become more productive. It's about getting involved with local schools and inspiring the next generation. It's about expanding the human possibility right in front of us. ■



# PRODUCTIVITY FOR THE FUTURE

The business models of larger OEM machine manufacturers are changing. Machine-builders are moving away from the traditional approach of selling machines and moving more toward selling production capacity, says Keith Atkinson of Weidmüller UK. The successful machine vendors of the future will be those that recognise and respond to this trend.

**F**orward-thinking machine vendors are constantly seeking ways to improve not just the short-term productivity of their machines, but also their lifetime productivity, which takes into account unplanned downtime and factors such as the production of out-of-specification parts that have to be reworked or scrapped.

But how can lifetime productivity be maximised? The design of the machine and the materials used in its manufacture inevitably play an important role in determining its reliability and performance, but improvements in these areas are increasingly difficult to make. There is, however, an innovative and very effective approach to maximising lifetime productivity of machines. This is to adopt industrial analytics.

In a nutshell, industrial analytics entails collecting data from a machine, analysing it, and making use of it. These days, collecting data isn't much of a problem – in fact, there's often too much of it! But raw data isn't useful in itself, because the valuable information it contains is concealed by a mass of routine and unremarkable results. This is where analytics comes in – sifting the wheat from the chaff, and alerting machine users to changes that may need their attention. And the last step – making use of the data – means responding to these alerts either automatically or through manual intervention. In short, industrial analytics makes possible the development of innovative data-driven business models.

Let's have a look at what this means in practice. An important element of industrial analytics is the detection of

anomalies, which is done by using machine-learning algorithms to look at key parameters relating to the machine and the products it is making. This approach is far more effective than conventional rule-based analysis because the algorithms learn what is "normal" for the machine and the environment in which it is operating, rather than using pre-determined rules that can only reflect what is normal for a typical machine in a typical environment.

Advanced machine-learning algorithms also use multi-dimensional data – that is, they take into account data from multiple sensors when making a decision about whether or not a particular data point is anomalous. Overall, the result is that these algorithms reliably detect anomalies that a rule-based approach would miss, and they detect the anomalies sooner.

Well-implemented algorithms not only detect anomalies, but also facilitate their classification. This allows the root cause to be determined quickly and easily, as well as allowing informed decisions to be made about the action that needs to be taken, which could range from simply keeping an eye on the situation, through scheduling maintenance during the next shutdown period, to stopping the machine immediately for maintenance to avoid the material and energy wastage associated with producing out-of-specification parts.

Industrial analytics also makes it possible to implement predictive maintenance. This differs from reactive maintenance, where machines are maintained only when a problem occurs, and also from preventative maintenance, where machines are maintained on a regular schedule whether they need it or not.



Predictive maintenance is data-driven and uses information about the past and current performance of the machine to make accurate predictions about its future condition.

This means that reliable assessments can be made about what needs maintaining and how urgently the work is needed, which has three benefits. The first is that the risk of unexpected breakdowns is greatly reduced, the second is that maintenance can often be planned to take place in scheduled machine downtime, and the third is that unnecessary maintenance "just in case" is eliminated. All of these benefits ultimately translate into cost savings, higher productivity and increased profitability.

A further important aspect of industrial analytics is that its algorithms can work with machine data to generate invaluable guidance on ways in which energy savings can be achieved. For example, does a particular cooling fan really need to run continuously, or is it only needed at certain stages in the machine's cycle, or perhaps only when the ambient temperature is higher than usual? With energy costs seemingly set to continue to increase indefinitely, this facet of industrial analytics is a definite benefit for machine end-users. And it is not only the end-users of machines who stand to benefit from industrial analytics – machine vendors also have much to gain. Predictive



maintenance, where the machine provides an early warning of the need for attention, allows the vendors to make much more effective use of their service teams by planning site visits in advance and by ensuring that such visits are only made when definitely needed.

Effective management of machine vendor service teams is important today and will be even more important in the future. This is because constant pressure to reduce costs means that fewer and fewer manufacturing companies can afford the luxury of an in-house maintenance team with the wide range of skills needed to maintain all of the equipment on a site. Instead, companies will in future rely on the machine vendors to fulfil their service needs, so those vendors that use industrial analytics to optimise service delivery will have an enormous competitive advantage.

It's clear that a strong case can be made for implementing industrial analytics, but what does this implementation involve? For most machine vendors, the first step is to choose an automation partner with proven expertise in this new and fast-developing field. Weidmüller, one of Europe's leading and most experienced proponents of industrial analytics, is just such a partner.

The actual implementation process involves multiple stages, typically spread over a period of several months. The first stage is a discussion with the machine

manufacturer to explore possibilities, define the targets for the project, and carry out a preliminary investigation of the problems to be solved. The next step is for the industrial analytics partner to evaluate the data available from the machine to verify that that it is sufficient and of high enough quality.

While, on the face of it, this may sound straightforward, in practice, data evaluation requires considerable expertise from the analytics partner to judge reliably where to draw the line between insufficient data and too much. It is also an interactive process that may, for example, lead to recommendations for adding sensors or enabling the built-in data collection features of machine components such as variable-speed drives.

After the quality of the data has been verified, the project proceeds to the proof-of-concept stage, where experts from the industrial analytics company learn in depth about the operation of the machine and its characteristics, and work off-line with sample data to develop custom algorithms that will make it possible to achieve the project's targets. This is one of the most crucial stages, and can only be carried out successfully by an analytics company with the wide experience of machines and control systems needed to understand all facets of their normal operation and potential failure modes. Algorithm development is a task that's far from trivial and, as yet, there are very

few companies with a proven track record in this area.

The penultimate stage is to carry out a pilot study on a functional prototype machine and, during this stage, the algorithms are likely to be refined further. Also during this phase, the benefits accruing from the use of industrial analytics become fully tangible for the first time, and the machine vendor is in a position to start demonstrating them to potential machine purchasers, thus starting to reap the rewards of their foresight and investment.

When it has been fully tested and proven during the pilot study, it is time for the last and most exciting phase: rolling out the industrial analytics system to production machines. For machines in series production – which are the main target for industrial analytics – this final step is typically easy and inexpensive, as the additional hardware requirements are minimal in most cases.

As we've seen, thanks to the use of industrial analytics, machine vendors can offer their customers what they really want – productivity, reliability and, above all, profit. And the machine vendors can also benefit themselves, not least by making their service operations more efficient and effective. ■

BELOW: Machine builders and users can both benefit from industrial analytics



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