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WELCOME

Victoria Montag, head of GAMBICA's Industrial Automation section, reflects of what has changed – and what has not – since the publication of the first GAMBICA Handbook, in association with Drives & Controls, two years ago.

"I'm writing this introduction just a few days after the general election in the UK." These words were written by my colleague Steve Brambley by way of introduction to the first GAMBICA Drives & Controls Supplement in 2015. Though I am writing this a few weeks before a general election, not after, these words have made me reflect on not only how much has changed in the past two years, but also how relevant Steve's introduction still is.

Two years ago, the polls had suggested the country was on track for its second coalition government. Instead, the Conservative party won enough seats to form a majority government. A year later the polls suggested that the British public would vote to remain within the European Union, but a few months ago, Article 50 was invoked. The current polls suggest that the Conservatives will increase their majority in Parliament. By the time this is published, we should know if the pollsters got it right this time, but if the past two years have taught us anything, it is this – the political landscape is a) unpredictable and b) ever-changing.

In an environment where the UK could, in theory, have had three different Prime Ministers and governments in as many years, British industry requires, as a minimum, some continuity between administrations. As acknowledged by Steve in 2015, "continuity of policy and application is one of the roles of the many government departments and agencies". But with every general election comes a hiatus in activity and uncertainty, first from the weeks of purdah and then from the inevitable reshuffle that brings new ministers who have new priorities and need educating on the challenges of the departments under their stewardship.

Therefore, a strong and consistent message from industry to government on topics such as industrial strategy, Industry 4.0 or apprenticeships remains as important as ever. GAMBICA's commitment to working with our members, other associations and stakeholders is to provide government with a strong and coherent industry voice, encouraging continuity in their interaction and focus on industry through every change the political sphere goes through.

GAMBICA also uses this voice to influence the world of technical standardisation and regulation. We impact European and International standards through our member experts who are nominated to BSI committees. In 2016, GAMBICA was ranked second by BSI for standards committee representation.

Though Article 50 has been invoked, we remain in the EU for the time being and so our work on European standards and regulations continues, engaging with the European government and sector committees as we did two years ago. Beyond 2019, these relationships that will be just as important while the British government starts to divest itself from European regulations but our members continue to follow them in order to export to the bloc.

We live in interesting times, and GAMBICA will continue to deliver value to their members by:

- advocating and encouraging the uptake of automation technologies in UK industry;
- educating end-users and debunking the misconceptions surrounding automation; and
- providing thought leadership, not just on automation, its technologies, innovations, standards and regulations, but also on topics such as Industry 4.0.

We will do this by working and collaborating with Catapults, the UK and devolved governments, academia and anyone else who seeks the same goals as us, writing technical publications, speaking at conferences and seminars, participating in exhibitions such as Drives and Controls – or press campaigns and articles such as this one.

So, welcome to the second GAMBICA Drives & Controls Supplement. I hope that you will find the content of this publication informative and useful. We would really value hearing from you on any subject you feel inspired by. Whether to pass on your point-of-view, to engage or collaborate with us, or to discuss membership benefits, please don't hesitate to get in touch. ■

GAMBICA

GAMBICA – the UK trade association for the industrial automation, control, instrumentation and laboratory technology sectors – can trace its history back more than 100 years. It plays a vital role in a wide range of technological, legislative and commercial issues affecting these sectors. In this exclusive *Drives & Controls* supplement, we look at some of the many and varied activities in which GAMBICA and its members are involved, and some leading members contribute their thoughts on topics of importance to the sector.



INDUSTRIAL STRATEGY

GAMBICA's director of public affairs, Steve Brambley, outlines how the organisation is responding to the Green Paper on industrial strategy that the Government published earlier this year.

In January 2017, the government published its long anticipated Green Paper entitled "Building our Industrial Strategy". It sets out a broad vision for a modern industrial strategy, underpinned by ten pillars (listed below in priority order, according to a GAMBICA member survey):

- Developing skills
- Investing in science, research and innovation
- Encouraging trade and inward investment
- Upgrading infrastructure
- Driving growth across the whole country
- Cultivating world-leading sectors
- Delivering affordable energy and clean growth
- Supporting businesses to start and grow
- Creating the right institutions to bring together sectors and places
- Improving procurement.

The green paper also poses 38 questions that are related to the ten pillars intended to help government understand which aspects are considered by industry to be the most important and if any areas have not been covered.

GAMBICA is responding to the consultation in two ways. Both are being done jointly our fellow trade association BEAMA (which represents manufacturers of electrical infrastructure products and systems) in order to create a wider industry representation.

First, we are providing a response to the 38 questions based on member surveys and industry positions. This has been compiled and submitted to BEIS (the Department for Business Energy and Industrial Strategy) as per their consultations. Second, we are developing a "Sector Deal" proposal, outlining what initiatives we as an industry will undertake and what form of government support is needed to enable this.

The electrotechnical-sector deal proposal is being led by GAMBICA and BEAMA, but also has input and endorsement from a range of other related trade associations and industry bodies, such as NMI, ECA and BESA. This collaboration not only raises the size of the industry voice, but helps to meet one of the government's aspirations for industry to be "self-organising". ■

If you would like to know more about our continuing engagement on Industrial Strategy, please contact steve.brambley@gambica.org.uk



GAMBICA'S COUNCIL STRUCTURE

GAMBICA's Industrial Automation Council (IAC), Process Instrument & Control Council (PICC) and Laboratory Technology Management Committee (LMC) are arenas where the decision-makers in our member companies can exchange sector-specific opinions, discuss the current market trends, their drivers, and common interests – for example, Industry 4.0, 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, as well as via the chairpersons, who are GAMBICA board members, at the association level.

The current chairpersons of the three Councils are:

Process Control: **Steve Leach, Siemens Plc.**
 Laboratory Technologies: **Eilidh Robertson, VWR International**
 Industrial Automation: **Ian Clarke, formerly of Rittal**

If you would like to find out more about the Councils, please contact the relevant sector head.





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STATISTICS

A key service that GAMBICA offers its members is the collection and analysis of data for the markets that it covers. The organisation 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, specially commissioned by GAMBICA for our members, gives an economic growth forecast for the UK and world economies, and provides an outlook for a number of major sectors. The biannual event, and the accompanying report, are widely regarded as a great advantage for planning future market strategies and forming budgets.

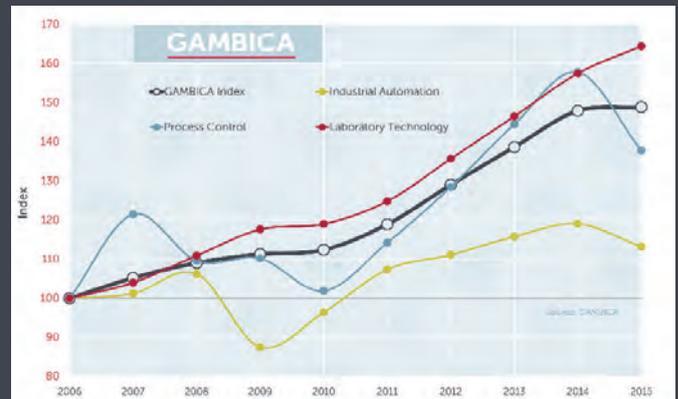
As good as Oxford Economics is, it is GAMBICA that provides its members with the data that lets them benchmark against the rest of the UK industrial automation market. We collect market data monthly and quarterly, and report back to participating members on aggregated industry-wide data, by sector, product,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

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

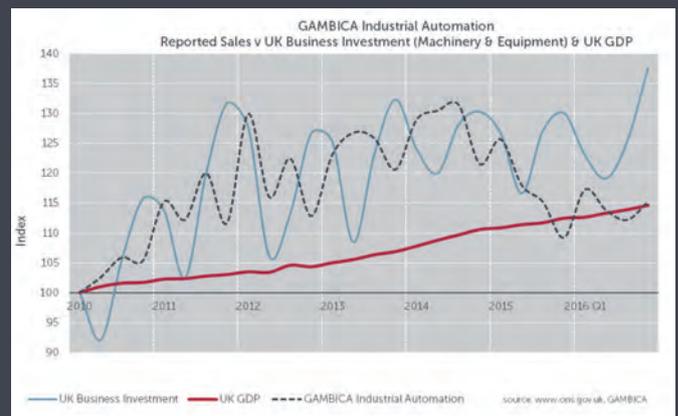
- Variable Speed Drives
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- Encoders*

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.

*Participation in this data collection is not included in standard Gambica membership



GAMBICA provides statistics for each of the market sectors that it covers, as well as an index for the industry as a whole



GAMBICA also offers more detailed breakdowns of the industrial automation sector and how it is doing compared to the UK economy and other indicators



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

INDUSTRIAL AUTOMATION TECHNICAL COMMITTEES

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

They take part in forums which keep members up-to-date on 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. GAMBICA has the second-largest representation of any organisation on BSI committees.

The TC members also interact with European sector organisations – CAPIEL for controlgear, and CEMEP for VSDs – and through these activities are engaged in the development and amendment of regulations and directives.

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

The Controlgear and VSD Technical Committees are also keen to share their knowledge. They regularly produce guidance documents with the aim of clarifying or simplifying the standards and regulations affecting their industry. These guides can be downloaded by anyone, without cost, from the GAMBICA Web site. ■

The GAMBICA Industrial Automation Technical Committees are open to all GAMBICA members. Please contact Victoria Montag if you would like to get involved.

GAMBICA produces a series of guidance documents on a variety of topics, that can be downloaded freely from its Web site



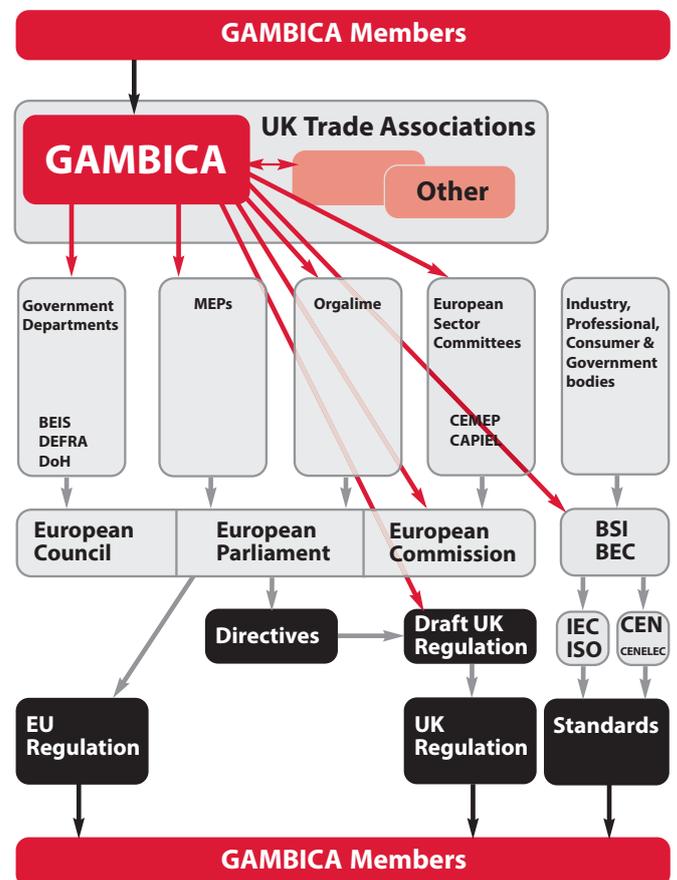
GAMBICA

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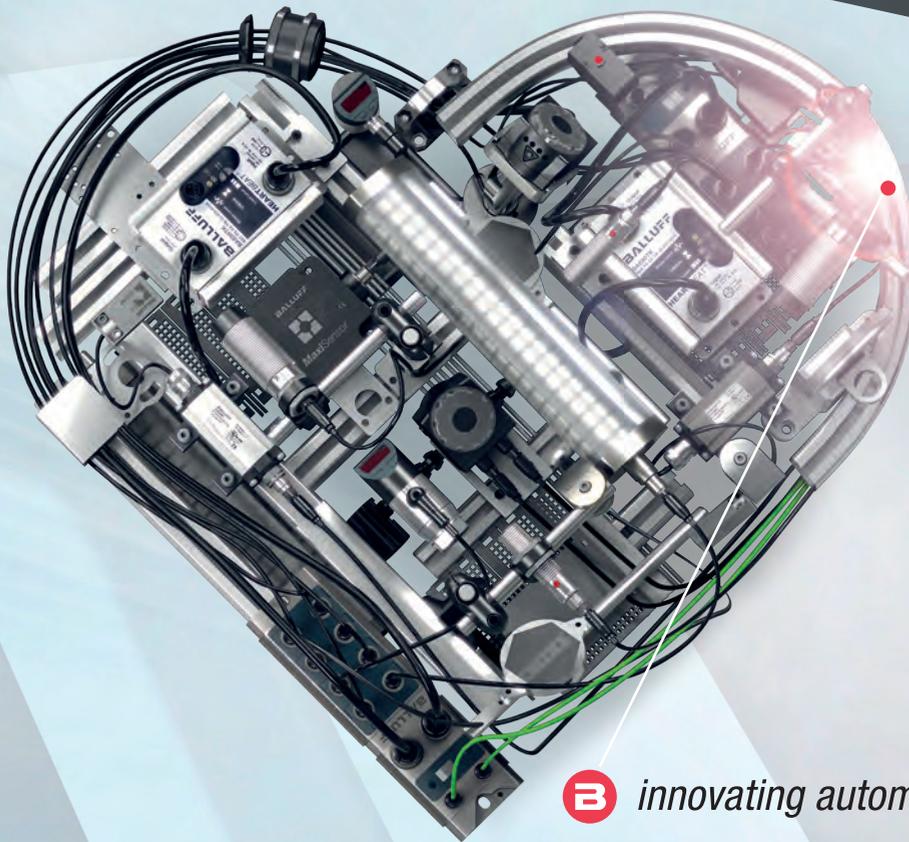
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GAMBICA plays a vital role in helping to draft UK, European and international standards

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GAMBICA member industry representation

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Industrial Automation



Process Instrumentation & Control



Test & Measurement



Laboratory Technology

Our Activities



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Market Data & Trends, Economic Forecasts, Opinion Surveys



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UK INDUSTRY: READY TO ADAPT?

We are living through an age of change. But Mark Bottomley, UK country director for Rockwell Automation, contends that UK manufacturing will adapt well to these changes and compete successfully on the global market.

With the UK grappling with its future relationship with the European Union and the outcome of a snap general election, Donald Trump working away in the Oval Office, and all manner of technological revolutions in full swing, it seems that change is everywhere you look these days. Whatever our feelings of jubilation or trepidation about this new paradigm, I am sure that here in Britain we'll continue to see plenty of fresh surprises even while we try to adapt to those we've already had.

And adapt we will! We're actually very good at it, and flexibility may prove to be the watchword of our times.

So it's with a note of cautious optimism that we advance into a new era. Perhaps "steady as she goes" best sums up the mood amongst the industrial leaders that I speak to here in the UK.

As Brexit negotiations and realities begin to have more and more of an effect, the change in the value of Sterling is making the environment more challenging for many in industry – and more positive for others. Meanwhile, global trends continue to exert a powerful influence.

There are probably a hundred such trends that are worthy of closer investigation. One that we are particularly interested in is hacking. In recent years, issues around network security have come into sharp focus – most keenly observed by Jim Labonty of Pfizer in his excellent address at Automation Fair back in 2016, when he revealed that his company faces around a million attacks on its network every single day.

Hackers only need to get "lucky" once, and it's only by dedicating resources and taking a defence-in-depth approach that UK industry can rise to meet this global challenge.

Similarly, Bank of England Governor Mark Carney has made headlines with his public statements on the future of the UK's job market and the threat he believes automation poses to the workforce. He has warned that traditional sectors such as accountancy may be wiped out by a new generation of software, putting up to 15 million UK jobs under threat. This general point about automation is one we know well from the industrial sector, which has seen consistent falls in low-skilled employment for many years.

Protecting the UK from global forces and the digital revolution simply isn't feasible, and the argument that the more automated industrial economies employ more people because they are more competitive remains as relevant as ever.

In fact, it's a point that was discussed in Deloitte's From Brawn to Brains research, which painted a fuller understanding of the effects of technology on the workforce – observing that although 800,000 lower-skilled jobs have been lost in the UK, technology has helped to create nearly three and a half million skilled ones in their place. It also estimates that these jobs pay an average of £10,000 more per annum and have added £140bn to the UK economy in new wages.

The fact is that for UK industry to remain sustainable and to grow, it must continue to invest in world-class manufacturing methods. A key consideration for safeguarding industrial employment is understanding the types of job that are going to be available in industry.

There remains the need to address a skills shortage for the next generation of the workforce through STEM initiatives at schools, and to offer flexible further education that will allow young people to pursue a career in modern industry.



Mark Bottomley

To that end, we welcome the government's efforts so far in producing and implementing a new industrial strategy. It is particularly good to see some attention being paid to STEM and skills development. Continued investment in upskilling the existing workforce so that they can fulfil the needs of today's industrial environment is at the heart of a comprehensive and forward-looking approach.

There's no doubt in my mind that only by taking the lead on such issues will the UK maintain a competitive and sustainable industrial sector in the face of fierce global competition.

In these times of change, UK industry needs to chart a course through skills issues, Brexit manoeuvres and global trends, and there's every reason to believe it is more than capable of doing just that.

My stoic optimism is best evidenced by the UK automotive industry.

Car manufacturing has long been held up as a guide to the overall health of UK industry and companies such as Jaguar Land Rover have continued to invest in world-class facilities and have seen gains in efficiency, productivity and a steady rise in profits as a result.

This is no fluke and demonstrates that the UK is capable of doing much more than just keeping its head above water.

So, while we may have to navigate some choppy waters in the years to come, there's no reason to think that the UK won't continue to do what it's always done – work hard to come up with great products and services that the rest of the world wants to buy. ■

MOMENTUM DRIVES SCOTLAND'S JOURNEY TO THE NEW REVOLUTION

Dr Graham Kerr, Technical Director, and Gavin Burrows, Project Manager, at CENSIS, the Scottish Innovation Centre for Sensor and Imaging Systems, report on initiatives designed to help Scottish manufacturers to participate in the fourth industrial revolution.

Scotland has a proud manufacturing tradition, playing a pivotal role in the first industrial revolution and defining many of the technologies that it came to be known for. As we approach the fourth sweeping change of the business world – more widely referred to as Industry 4.0 – momentum is building behind placing Scotland's industrial base in the vanguard of a global transformation once again.

To make this happen though, there's a battle for hearts and minds to be won. Industry 4.0 may be a daunting prospect for some – albeit it's unlikely to be the top priority for many manufacturers on a day-to-day basis. It's understandable that some will have put it to the back of their minds, instead trying to focus on running and growing their businesses.

It's a sentiment substantiated by the stats. A report[‡] from BDO and the Institution of Mechanical Engineers last year found that while 59% of UK manufacturers recognised that the fourth industrial revolution will have a big impact on their sector, only 8% said they have a "significant understanding" of what it means.

The figures are likely to be lower still for manufacturing SMEs, which make up a significant proportion of Scotland's industrial base: Scottish Government analysis shows that 99.3% of Scotland's private sector is made up of small and medium-sized enterprises. It is, therefore, imperative that steps are taken now to engage these companies in Industry 4.0, if we are to make the most of the opportunities it presents.

Significant progress has been made on that front in the past 18 months. Our ultimate destination was outlined in Scotland's MAP[‡] – the country's manufacturing action plan – which included opportunities presented by investment and product development in the IIoT (Industrial Internet of Things). Although in its formative stages, this vision will have a key part to play in

defining how Scottish manufacturers adapt to the new digital reality.

However, as the above polling clearly demonstrates, industry needs to understand what that opportunity is first and to give serious thought to what it means for their businesses – they don't have to do everything the IIoT offers; implementing a small part of it can reap significant rewards.

To address this issue, a consortium of organisations, involving CENSIS, Scottish Enterprise and the University of Strathclyde's Advanced Forming Research Centre (AFRC) – part of the UK High Value Manufacturing Catapult Centre – is evaluating the development of a regional digital manufacturing innovation hub. Called Innovation for Manufacturing SMEs (I4MS), the initiative is a European Commission-backed project designed specifically to help companies build capabilities, explore new and different business models, collaborate and develop integrated supply chains.

While we have a goal and we're developing a way of facilitating that vision, there's still another issue to tackle: the perennial challenge of skills. This is where the National Manufacturing Institute for Scotland (NMIS) – announced last year by the Scottish Government – comes in. One of its principal aims will be to teach SMEs how to engage with Industry 4.0 by providing training for businesses, organising day-long programmes and on-the-job training, as well as qualifications from apprenticeships all the way through to engineering doctorates.

Nevertheless, these initiatives need to be supported by organisations that can help businesses foster and accelerate innovation – centres, like CENSIS, designed to talk to businesses and develop powerful, relatable case studies. Our IIoT Centre, for example, is designed specifically to progress Internet-of-Things products and deliver workshops and mentoring, through programmes such as



Dr Graham Kerr



Gavin Burrows

IoTUK Boost and the soon-to-be-launched IoT Explora.

Encapsulating the progress that's been made recently is one of Scotland's first Industrial IIoT demonstrators at the AFRC. The project is analysing the use of low-cost sensor technology in machinery to cut the cost of maintenance, minimise downtime, and detect faults by recording and analysing a range of data – including vibration and temperature. The result will allow predictive maintenance to be implemented and help improve the efficiency of machines, with the aim to use the technology to help businesses boost their bottom line.

It's clear that great strides have been made in the past 18 months as Scotland seeks to position itself among the frontrunners in the global Industry 4.0 race. The first crucial steps have been taken, but there's still a great deal of ground to be covered. To get to the next stage, we need more manufacturers to engage with what's happening and take up the baton of change – and the time to act is now. ■

‡ <https://goo.gl/fe7L6D> ▲ <https://goo.gl/hfdkbl>

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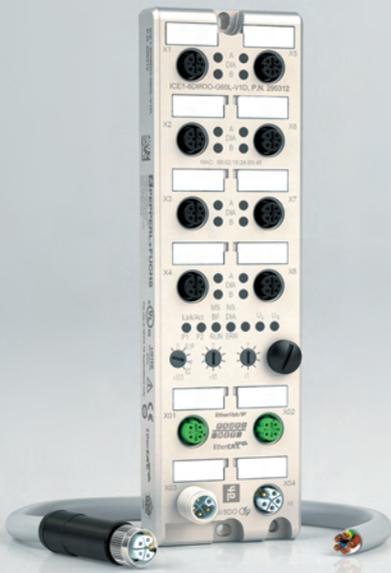
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FAST, FLEXIBLE MACHINES POSE A CHALLENGE TO MACHINE-BUILDERS



Intelligent machines are the foundation of smart factories. Incorporating the right capabilities into their designs poses new challenges for machine-builders. Mark Turner, applications manager at Lenze, explains.

Industry 4.0, originally devised by strategists in the German government, has captured the imagination of researchers, policy-makers, technology companies and manufacturing organisations around the world. Here in the UK, the Industrial Internet of Things (IIoT) can be considered as broadly being the same. The recipe is simple: combine the capabilities of today's computer systems – fast, flexible communication and the ability to crunch vast quantities of data – with the flexibility of modern automated manufacturing equipment. The resulting agile, intelligent machinery and supply chains should allow companies to give their customers more of what they want, when they want it, while cutting costs and waste.

For machine-builders, the concept is not new. Automation systems have relied on network technologies for decades, often for very pragmatic reasons. Fieldbus

networks simplify the design of control systems, making it easier to build, maintain and modify equipment. At the component level, many of the key enabling technologies for Industry 4.0's "cyber-physical systems" are exactly the ones that companies are using already.

New mindset

However, Industry 4.0 does have some important implications for machine-builders. Firstly, they need to be aware that their customers are adopting Industry 4.0 strategies at the boardroom level. That pushes decisions about technology choices and investments up the corporate agenda and requires the machine-builder to demonstrate the value of smarter solutions and more capable designs.

Secondly, Industry 4.0 requires both machine-builders and users to think about their automation systems in a more integrated way. For example,

they will need to collect, store and analyse more data, and distribute control and decision-making to different parts of the organisation. Rising levels of automation means they will also have more equipment to monitor and manage. To achieve their goals while keeping complexity under control, end-users will increasingly seek to standardise the way data is handled and communicated across their organisations. That, in turn, means machine-builders must be able to offer equipment that complies with the customer-specific standards.

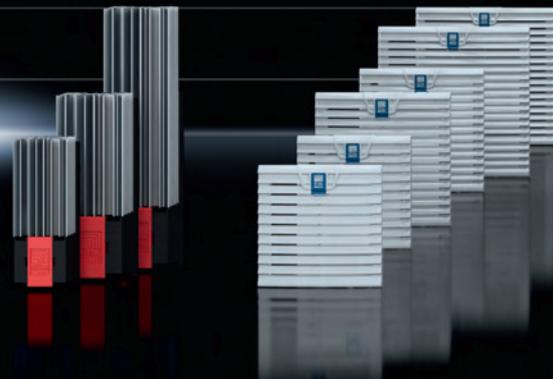
Finally, Industry 4.0 means end-users will ask more of their machine-builders. They will want more capable, flexible machines, fitted with more sensors and equipped with more motion axes. Also higher levels of performance, reliability and availability. There will be new services to consider. Smart machine technologies offer a

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wide range of potential benefits, and users will make decisions about which functions matter to them, and how they will be used. It is likely that many companies will see activities such as condition monitoring of machine components as being candidates for outsourcing, and they may look to their machine-builder partners to offer those capabilities.

To meet the changing requirements of their customers – and capture the new business opportunities those requirements create – machine-builders need to make the right decisions about the technological building blocks of their products. The actuators, drives, controllers and other components they select for a project will determine not only the capabilities of the final machine, but also the cost and difficulty involved in providing those capabilities. Industry 4.0 capabilities must be designed in to the machine from the outset.

Industry 4.0 will place increasing demands on machine communication networks, for example, requiring them to handle more types and larger volumes of data while still offering the deterministic performance necessary for safe and reliable machine control. Builders will also need to be comfortable offering systems that use their customers' preferred network standards. Those objectives are easier to meet if the chosen automation systems are compatible with a wide range of different network types.

Choosing the most capable components for an application need not be complex and costly. As an example, consider variable-speed drives where servo technology is often chosen. While brilliant in highly dynamic, high-speed motion applications, servo systems can sometimes be replaced with significant cost savings by increasingly-powerful conventional motors and drives. High frequency (120Hz) motors and drives, for example, offer a speed range five times wider than 50Hz units. On simpler machines, exploiting the control capabilities of modern drives can even eliminate the requirement for a separate control system.

Reducing project times
Machine-builders also need to consider the tools and support available to develop smart machine applications. While customers will demand more complex functions to support their Industry 4.0 ambitions, they will still require machines to be delivered as quickly and cost-effectively as possible.

Modern control systems can communicate almost any desired parameter over the network. A key challenge in developing integrated manufacturing environments lies in deciding exactly what data is useful. Automation system providers can offer valuable support here – for instance by suggesting data that can predict potential reliability issues.

The right development environment is also critical. Leading automation providers offer time-saving modular control software. Robust, tested modules cover a wide range of common machine applications – from feeding, unwinding and sealing on packaging lines, up to complete robot control. Programmers can then work much more efficiently knowing that an architecture based on autonomous modules is safe and proven. Functions are encapsulated in the modules, which can be exchanged and tested independently. This makes engineering quick, easy and reliable. Research indicates that up to 80% of the time to develop machine control applications can be freed.

Access to properly tested and proven off-the-shelf software technologies can also simplify dramatically another key Industry 4.0 requirement: the secure transfer of machine data to the cloud. Automation providers must offer technologies that allow machine information to be shared across wider networks without risk of compromise or misuse. That enables seamless integration with customer systems and helps machine-builders to offer added-value services such as remote monitoring or predictive maintenance.

The challenge of Industry 4.0 is to build smarter machines, which means working smarter. The choice of automation system and provider is the key to giving end-users the performance and functions that they are coming to expect. ■



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A CASE OF DÉJÀ VU?

Engineers who worked through the 1990s might be experiencing a sense of déjà vu with all the talk surrounding Industry 4.0, thinking that it sounds very much like the concepts of Computer Integrated Manufacturing (CIM). However, Mitsubishi Electric's Chris Evans argues that Industry 4.0 has really moved the debate forward and is helping industry to address a new set of challenges.

It's easy to be cynical in manufacturing. For example, we could quite easily make a case for saying that there are no new ideas, simply new names for old ideas. Concepts, buzzwords and catchphrases can quickly become bandwagons, picking up a head of steam in no time, but fading from public consciousness just as quickly when the next big thing comes along.

Could we say the same about Industry 4.0? Might it be that it's really just a rebranding of CIM? The origins of CIM can be traced as far back as the 1970s, with the publication of the book *Computer Integrated Manufacturing* by Dr Joseph Harrington. By the 1990s, it had gained traction both as an idea and as a realisable goal, thanks to the increasing power of PLCs on the plant floor and of desktop computers in the IT department.

CIM was defined as the integration of the total manufacturing enterprise by using integrated systems and data communications, coupled with new managerial philosophies that improve organisational and personnel efficiency. In a CIM system, functional areas such as design, analysis, planning, purchasing, cost accounting, inventory control and distribution are all linked through computers with factory-floor functions, providing direct control and monitoring of all operations.

All of that sounds very familiar in the context of the current Industry 4.0 debate – so is Industry 4.0 merely CIM 2.0? The cynical among us might say so. They might go on to add that Industry 4.0 is nothing more than a marketing device dreamed up by the German government.

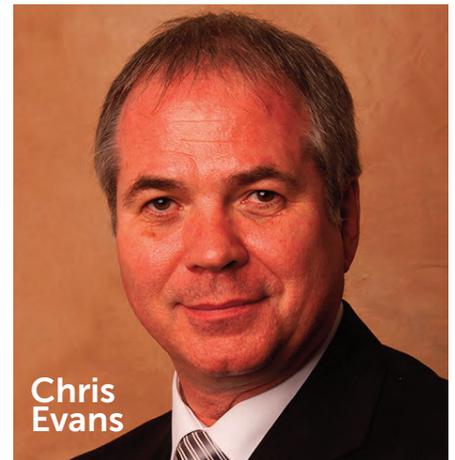
However, let's put that cynicism behind us and focus not on the branding of

the idea, but rather on how Industry 4.0 really does provide a context for addressing the manufacturing challenges of today – and of the future. Manufacturers are facing increasing competition on a global scale, with a need to facilitate ever-greater levels of customisation in the production of goods to meet the individual needs of customers. Indeed, where once we talked about moving from mass production to mass customisation, we're now going even further to talk about "batch size 1".

All of this requires unprecedented levels of manufacturing flexibility and agility, bringing in advanced concepts of production line adaptability, self-configuration, self-optimisation, predictive maintenance and more. It also has implications for the complete supply chain, enabling production operations to be tied in not only with materials supply but also with real-time customer requirements.

Industry 4.0 doesn't simply say that this ought to be possible, it shows us the framework for making it possible. It also benefits from 20 or more years of technological development since the heyday of CIM, with massive advances in communications, open standards and processing capabilities, along with the rise of the Industrial Internet of Things and the power of the Cloud. Analysts and experts might postulate that we may be 20 years from factories that truly epitomise Industry 4.0, but actually we have right now everything we need in terms of technology not just to make the first tentative steps on an Industry 4.0 journey but to realistically implement the vast majority of its goals.

Defined as the fourth industrial revolution, Industry 4.0 is indeed driving a revolution in manufacturing. It is already enabling new levels of



manufacturing flexibility and allowing a seamless flow of information not just around the individual plant but across all of a company's plants around the world and throughout its supply chain. It is driving a complete change in mentality not just of how products are made, but where in the world they are made, with the ability to match global production capabilities with regional customer requirements.

There will be many challenges along the way, not least of which are the current levels of automation and network infrastructure found within many UK manufacturing plants which may or may not exist but are critical to achieve the convergence of the business level and manufacturing plant which provides the conduit to realise the concepts of Industry 4.0 and smart manufacturing.

There will undoubtedly be cynics out there who will look at Industry 4.0 and do nothing more than say: "Here we go again." I wonder how many of those companies will still be here in ten – or even five – years' time? Because we really are in the midst of a new industrial revolution and it has major implications for the future. ■



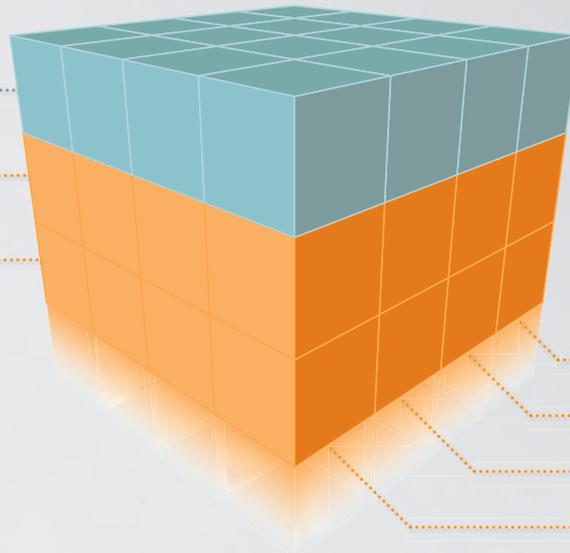
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OPC UA AND TSN: THE SUCCESSOR TO FIELDBUS?

The combination of OPC UA and TSN could redefine the way real-time communications take place in factories, changing network architectures and replacing traditional fieldbuses on the shopfloor. B&R Automation's marketing manager, Stefan Schönegger, explains.



Stefan Schönegger

components will be available quickly and relatively inexpensively.

OPC UA TSN bridges the gap between the IP-based world of IT and the field of factory automation. OPC UA TSN is the perfect solution for all applications in factory automation. With sub-millisecond synchronisation, it offers sufficient precision for tasks such as line synchronisation, Scada system integration, basic control tasks or even conveyor belt operation and I/O integration.

OPC Unified Architecture (UA), released in 2008, is a platform-independent machine-to-machine communication protocol developed by the OPC Foundation. From a technical standpoint, it would be feasible to add real-time capabilities to OPC UA, but doing so would involve considerable effort and would have disadvantages. That's why a large group of automation and robotics manufacturers have joined forces to move in a different direction – allowing OPC UA to take advantage of Time Sensitive Networking (TSN).

TSN is a set of extensions currently in development that will later be included in the IEEE 802.1 standard. The goal is to provide real-time data transmission over Ethernet. A significant advantage of the TSN standard is that the automotive industry is behind it. That means that the required semiconductor

OEMs and system integrators have high hopes for OPC UA TSN. So far, those hopes have been based on theoretical concepts and technologies still under development – but not any longer. A group of automation suppliers has proven the ability of OPC UA TSN to meet communication requirements from the line level up to the ERP level under real-world conditions (see box, right).

B&R has also performed intensive field-testing with the TSN network specialist, TTTech. The results are impressive and, in some aspects, OPC UA TSN has even outperformed our expectations.

Time-critical applications at the line level, such as synchronisation of conveyor belts with various other equipment, require cycle



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times as low as two milliseconds. We've gone even lower than that on our test installations. With jitter measurements as low as 100 nanoseconds, the results were on par with the best fieldbus systems on the market today.

Reduced network traffic
With our bus controller implementation, we have also tested an important new feature of the OPC UA specification. The publisher-subscriber (pub/sub) model plays a key role in allowing OPC UA TSN to achieve the necessary performance.

Until now, OPC UA has used a client/server mechanism, where a client requests information and receives a response from a server. On networks with large numbers of nodes, traffic increases disproportionately and impairs the performance of the system.

The publisher-subscriber model, in contrast, enables one-to-many and many-to-many communication. A server sends its data to the network (publish), and every client can receive this data (subscribe). This eliminates the need for a permanent connection between client and server, which is particularly resource intensive.

An OPC Foundation working group is developing the specification for OPC UA's pub/sub model. The momentum behind the OPC UA movement is evident in the number of standards organisations basing their work on the vendor-independent protocol. Euromap, which develops global standards for

the plastics industry, recently defined OPC UA as the basis for two new interfaces, and more are on the way.

Omac, the umbrella organisation for the packaging industry, will also be integrating OPC UA into its PackML standard and is already working on specific implementations. It really is astonishing how quickly such well-established industry standards are now turning to OPC UA. The performance demonstrated by our field-testing with OPC UA TSN confirms that they're moving in the right direction.

The other impressive thing about the test installations is their stability. After all, we're working with technology so new that its IEEE specification hasn't even been completed.

Pivotal to practical applications of OPC UA will be its code size and resource requirements. If OPC UA could only run on powerful industrial PCs and controllers, use in machinery and equipment would be out of the question. By implementing OPC UA on a bus controller from its X20 system, B&R has demonstrated the feasibility of I/O-level applications for OPC UA servers and clients. It proves that OPC UA is perfectly scalable to any conceivable task at the line-level and beyond.

With OPC UA extending its reach to the level of line automation in the coming years, there will be some dramatic changes to the architecture of machinery and equipment. It will likely mean the end of factory-level fieldbus systems as we know them today. ■

THE IIC AND ITS TSN TESTBED

The Industrial Internet Consortium (IIC) aims to enable the intelligent networking of machinery, equipment and facilities. A primary goal of its founders GE, IBM, Intel and Schneider was to accelerate adoption of the Internet of Things (IoT).

To identify which technologies are best suited to IoT applications, the IIC organises testbeds, where technologies are evaluated on multi-vendor installations. In the IIC's TSN Testbed, the combination of TSN and OPC UA is being evaluated for the first time on a multi-vendor OPC UA network in an industrial environment. Participants in the testbed include National Instruments, Cisco, Schneider, Bosch, GE, Intel and TTTech, as well as B&R.



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AN OBLIGATION TO UK INDUSTRY

Adoption of Industry 4.0 practices and technologies is crucial for the future success of UK industry, and the automation sector has a powerful obligation to support this process. So says Simon Goodwin, managing director of Weidmüller UK.

Increased productivity, higher efficiency, lower costs, reduced energy usage, a more agile response to customer requirements – the benefits of Industry 4.0 have been spelled out almost ad nauseam. And there's no denying that they're beguiling, not least because it's clear that any manufacturer missing out on these benefits will be disadvantaged.

Yet the response of UK stakeholders is still decidedly mixed. The automation sector is the most active proponent of Industry 4.0 and machine-builders are also enthusiastic. Systems integrators are on board but many seem bemused, as they have been supplying many of the technologies that underpin Industry 4.0 for some time now.

The most important stakeholders are, undoubtedly, the end-users, as it is they who decide when and how much to invest in Industry 4.0. And there's a huge variation in responses from end-users. Some are embracing Industry 4.0 enthusiastically, but others are much less active.

Typically, these less active businesses are aware of Industry 4.0, but lack the confidence to take what they perceive as an enormous – and potentially expensive – step into the unknown by adopting Industry 4.0 practices and technologies. The automation sector has a great and pressing obligation to imbue these companies with the confidence they need to commit wholeheartedly to Industry 4.0.

How is this to be done? An essential step is to make the benefits more tangible. It's all very well saying that Industry 4.0 will cut costs, but this is a

very general claim. Much better, for example, would be to focus on energy costs and explain how Industry 4.0 allows energy usage monitoring down to machine level – and beyond – so that areas for saving can be quickly identified, along with anomalies that may indicate energy-hungry faults.

It is also important to highlight the transparency provided by Industry 4.0, which will allow every aspect of machines and processes to be monitored comprehensively, from individual sensors right up to the supervisory level.

The data produced by this monitoring, analysed by software that is also part of the Industry 4.0 paradigm, will not only reveal potential for efficiency and productivity improvements but will also highlight drifts in process parameters that could indicate a developing failure, allowing the failure and consequent loss of production to be averted.

These explanations will increase the appeal of Industry 4.0, but they do little to address the "fear factors" – Industry 4.0 is complicated, it's expensive, its success is uncertain and its implementation may be highly disruptive, especially if the wrong protocols are chosen.

To address these factors, the automation sector needs to acknowledge its obligation to industry by reassessing how it presents Industry 4.0 to end-users. Responsible marketing with consistent and meaningful messages is essential, as is the avoidance of empty and confusing claims such as stating that a piece of equipment is "Industry 4.0 ready", simply by adding an Ethernet port.



Points-scoring by companies trying to promote their products as "the true path to Industry 4.0" is also unhelpful. What's needed is a unified approach to promote the whole concept of Industry 4.0. When this has been successfully achieved, there will be plenty of opportunities for competitive selling further down the road.

It is also essential to explain that, except possibly in the case of new plants being built from scratch, moving to Industry 4.0 is an evolutionary process. The factory will not change overnight. Instead, the change will come in the form of small, affordable steps that will involve minimal disruption during implementation but will, ultimately, lead to a full Industry 4.0 implementation with all of its many benefits.

UK manufacturing needs Industry 4.0 and those of us in the automation sector have a vital role to play in ensuring that it is adopted as widely as possible. We must not shirk that role, nor let it become overshadowed by our own narrow commercial interests. In short, we must meet our obligations to support the delivery of Industry 4.0 to UK manufacturing. ■

IO-LINK: THE FOUNDATION FOR SMART SENSORS AND ACTUATORS

IO-Link is rapidly gaining popularity, allowing sensors and actuators to be integrated into smart factories at a low cost. Patrick Berdal, product manager for control devices in Parker Hannifin's European Automation Group, argues that the technology offers other attractions such as on-board diagnostics and easy installation.

As industrial devices are becoming more connected – boosted by trends such as the Industrial Internet of Things (IIoT) and Industry 4.0 – factories are increasingly using industrial networks to make their sensors and actuators more intelligent. This is driven largely by the need for better performance, flexible manufacturing and the desire to integrate factory installations with IT systems.

Communications-enabled devices are now used extensively to control industrial processes and machines in modern factories. Microprocessor-based systems provide advanced functions, such as analogue monitoring

and high-speed motion control, as well as data-sharing via communication networks. So, which of the various industrial networks are being used to implement the IIoT for motion control?

Different manufacturers have their own ideas of what a smart factory is. A common theme is the need for embedded components to have additional intelligence, thus enabling machine-to-machine communications and reactions. These ideas eventually come down to practical aspects, such as system architectures and how the multitude of new sensors – and an increasing number of actuators – will communicate via the network.



Selecting the right network is always going to be about what's most important to the manufacturer. The topology is also a key consideration for factors such as redundancy, future expandability, ease of implementation, and any special hardware that is needed to run the system.

Ethernet networks are gaining in



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popularity. Many of these networks and protocols are designed specifically for industrial applications, and some of the main benefits include integration with IT infrastructures, Internet connectivity and remote monitoring.

Many of the Ethernet networks and protocols – such as Profinet IO, EtherNet/IP, EtherCat and Modbus TCP – have been around for 15 years, but until now the high cost of installing them has limited their applications to those requiring the highest levels of sophistication. More economical fieldbus networks – such as Profibus DP, DeviceNet and AS-interface – have been used for less complex operations.

However, the current trend is for traditional fieldbuses to be squeezed out as the cost of Ethernet networks and protocols comes down, and as new technologies – such as wireless networks and open communications – emerge. One of these relatively new open communications protocols, IO-Link, is a perfect local extension to supervisory Ethernet networks, and could be the next significant industrial network protocol. Launched in 2008 by Siemens, it is the first IO technology for

communication with sensors and actuators to be adopted as an international standard (IEC 61131-9).

The high-performance, point-to-point interface is based on a three-wire connection with simple plug-and-play installation. IO-Link uses standard, non-shielded cables to connect slave devices to a master, cutting the cost of cabling by a factor of five compared to protocol-specific cables. If a device needs to be replaced, its configuration can be stored and downloaded to the new device, without needing any programming.

The key to unlocking the power of intelligent devices is in making diagnostic information easy to access. IO-Link supports cyclic data exchange so a programmer can send information where it needs to go – such as an HMI screen or signal light. If sensor or actuator parameters need to be changed or calibrated, this can be done remotely, even while the production line is running.

There are now more than 130 companies in the IO-Link community and more than 3.5 million nodes have been installed. Users have been won over by factors

such as: the rapid evolution of the technology; its ease of installation; and its control and diagnostics capabilities.

In any automotive or packaging plant, the “elephant in the room” is usually the large control cabinet housing the PLCs and contactors. These cabinets take up a lot of valuable floorspace, but they now seem destined to shrink dramatically. Power supplies, PLCs and Ethernet switches are becoming more rugged – going from IP20 to IP65 in many instances. With equipment such as safety relays increasingly moving out of the cabinet, we will start to see PLCs also moving out to machinery. Ultimately, factories will regain that premium space that was once occupied by the cabinet, with IO-Link masters allowing cables to be decentralised. Both will see dramatic reductions in cost.

This stripped-down “do more with less” model will encourage users who still usually hardwire equipment to make the leap towards industrial networks. They can now get a lot of information that they couldn’t before, simply because there is more intelligence in field devices, enabling flexible manufacturing and enhancing safety. ■



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