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Introduction

This important Manufacturing Technology Centre (MTC) conference was created primarily for end users and designed to create momentum at a national level, mobilising Government and private organisations to take actions which will drive the digitalisation of UK manufacturing industries. It aimed to provide leadership as to what to do and when to create transformational incentives and mechanisms to make major advances at a national level.

The MTC has been monitoring global developments in digital manufacturing technologies, as well as engaging on a national and European level. Pioneers of the Fourth Industrial Revolution in the UK were joined by experts from Germany and across Europe to share their experiences and provide advice on remaining at the forefront of business using the new technologies available.

Speakers at the conference were industry experts in digital manufacturing. Their focus was on understanding ways to drive the digitalisation of the UK manufacturing sector.

Visitors to the conference also had the opportunity to see training in digital manufacturing taking place in the MTC’s Advanced Manufacturing Training Centre and take part in technology workshops.
Welcoming the delegates, Ken Young said one of the things he was most interested in was how much or how little things had moved forward since the ‘From Industry 4.0 to Digitising Manufacturing’ conference held at the MTC in November 2015. He said many businesses in Europe still found the issue confusing. They knew they needed to do something, but were confused as to what.

In the UK progress was being made, with the establishment of an industry leadership group to look at skills and other issues which needed to be addressed from a national perspective. They were also taking a collaborative approach, with the High Value Manufacturing Catapult centres, the British Standards Institute, the University of Cambridge and others with input to offer, working together to move the agenda forward.
Professor Tim Dafforn, Chief Scientific Adviser, Department for Business, Energy and Industrial Strategy (BEIS)

“It’s real when it touches your friends”

Tim Dafforn outlined the general understanding in the UK of the meaning of ‘The Fourth Industrial Revolution.’ The first came about in the 18th and 19th centuries with mechanisation, steam power and iron. The second came in the early part of the 20th century with production lines, steel and telegraph communications, and the third came between 1950 and 1970 with plastics, air travel and the beginnings of computerisation.

All of these revolutions were characterised by increased productivity, increased use of technology and the adoption of innovations, and alterations in employment patterns.

He questioned if the Fourth Industrial Revolution, or Industry 4.0, was a revolution or simply accelerated evolution. He pointed out that the previous industrial revolutions had not been identified as such until 30 or 40 years later. However, it was a crucial issue first identified in Germany’s industrial strategy in 2011, with added momentum coming when it was highlighted at the 2016 World Economic Forum.

The fundamental principles, as recognised by BEIS, were:

- Interconnectedness of supply chains, businesses and customers, and the Internet of Things (IoT).
- Data and scalable cloud storage.
- Automated intelligence and rapid autonomous decision-making.

In summary, we are seeing a change to the business model, into ‘black box businesses’ encompassing customers, suppliers, business strategy, products, accounts and regulation. He used a real-world example of a patented melon slicer which was designed, engineered, commissioned for manufacture, made, marketed and sold, all from a mobile phone.

The positive implications of Industry 4.0 are that it releases the skills of the digital generation, draws upon the UK’s design strengths, and accelerates the ‘idea to market’ process, while removing administrative burdens, providing economies of scale to start-ups and simpler access to markets. However, there are downsides. For example, manufacturing can easily be off-shored, the service supplier takes much of the profit, it is not easily scalable and the process is limited to simple products.
SESSION ONE
Policy
Ernst Stöckl-Pukall, Head of Division, Digitisation and Industrie 4.0, German Ministry of Economic Affairs and Energy

“It will ultimately change every aspect of people’s lives”

In Germany, Industrie 4.0 recognises there will be exceptional and fundamental changes through digitisation, but sees those changes as transformative rather than disruptive. Currently we are seeing probably less than 10 per cent of what Industrie 4.0 can do. It will ultimately change every aspect of people’s lives, so everyone has to be involved.

The Federal Ministry for Economic Affairs and Energy has launched its Digital Strategy 2025 followed by an action plan. The strategy covers growth and employment, the regulatory framework, and the need for trust and security. In Europe the focus is being placed more on the industrial sector and engineering skills, whereas in the United States the emphasis is more on platform-related business models.

From a German Government perspective it is important that any regulatory framework which emerges allows for a single European digital market, ensuring a free flow of data while protecting data ownership, data protection and the use of data.

Digital Infrastructure

By 2018 at least 50 Mbit per second for everyone in Germany

Upgrade into a gigabit optical fibre network by 2025

Favorable regulatory environment for privat investment

Investment funds to support nationwide coverage
In Germany, a digital infrastructure is planned, which will provide internet speeds of at least 50Mbps for everyone in the country by 2018. By 2025 the target is to upgrade the infrastructure to a gigabit fibre optic network for all business. A favourable regulatory environment is required to encourage private investment, and additional public investment funds will be necessary to support nationwide coverage.

**“Plattform Industrie 4.0”**

- Multistakeholder approach
- Highly committed experts
- Five working groups: standardization, research and innovation, security in networked systems, regulatory framework, jobs and skills management
- Recommendations and practical guidelines

Germany’s Industrie 4.0 project is taking a multi-stakeholder approach with input from experts from companies, trade unions, academia and government. Five working groups have been established within the “Plattform Industrie 4.0” covering standardisation, research and innovation, security in networked systems, the regulatory framework, and jobs and skills management. The platform with its working groups has already produced a remarkable number of recommendations and practical guidelines.

In close cooperation with the working group for standardisation a new institution set up to drive forward standards on an international basis has been established in Germany. This includes the Standardisation Council Industrie 4.0 and the Labs Network Initiative. A standardisation architecture for Industrie 4.0, named RAMI 4.0, has been developed as a basis for discussion with international bodies (more about this later in this report). Internationally, the aim is to harmonise standards, share best practice, set up test facilities for mutual use and allow market access. Germany and the platform are engaged in bilateral cooperation activities e. g. with China, France, Japan and the Industrial Internet Consortium. As international cooperation is of utmost importance for “Industrie 4.0” the topic is also high on the agenda of the EU Conference in Essen in January 2017 and at a G20 Conference in Berlin in March 2017.

The skills issue is being taken forward with an emphasis on digital education. A comprehensive lifelong learning approach will introduce digital education to all stages of life, with vocational training and the adoption of best practices.

Supporting SMEs and start-ups is key, and SME 4.0 centres of excellence are being established with events, information, demonstrations and test facilities. An online map gives access to 250 examples of successful adoption of Industrie 4.0 principles.
Produktion2030 – Digitisation of Swedish Industry: Objectives, Initiatives and Mechanisms

Cecilia Warrol, Director, Produktion2030

"Key areas are sustainability and digitisation"

For a country of its size, Sweden has a large and internationally well-known manufacturing sector. With a population of 10 million people, more than one million work in industry. Manufacturing makes up 50 per cent of the country’s exports and 67 per cent of private sector research and development spend. There is already a mature level of digitisation in products and processes from manufacturers such as Volvo, Ericsson, ABB, Sandvik, Scania and Saab.

Sweden’s programme for innovation in manufacturing is Produktion2030. Its aim is to ensure that by 2030 production is sustainable and sufficiently resourced. The organisation underpinning the programme is the Swedish Association of Engineering Industry.

The programme involves industry, academia and research institutes. Collaboration between OEMs and SMEs is encouraged.

Impact!

- 30 projects
- 10 M USD
- 150 companies
- 125 SME:s
- 40% female project leaders

1. Projects
2. SME:s
3. Education
4. Mobility
5. Internationalisation

- 25 SME-packages
- National workshop tour
- Regional industry networks
- EU-impact
- Networks and analysis
- USA, Germany, India, Japan, Singapore, South Korea, ...

- 140 PhD students
- 30 new courses
- International production
- Exchange programmes between industry, academia and research institutes

- 30 projects
- 10 M USD
- 150 companies
- 125 SME:s
- 40% female project leaders
To achieve its objectives, the project has identified five strands:

1. Projects - using research and innovation with testbeds for users. 30 projects are under way, involving 150 companies including 125 SMEs. Forty per cent of the project leaders are female.

2. SMEs - producing usable packages for SMEs distributed through regional platforms. So far 25 packages have been produced. Regional industry networks have been established along with a national workshop tour programme.

3. Education - with courses available at master's level and a PhD school. So far 30 new courses have been established and there are 140 PhD students. Studying international production methods is a key part of this.

4. Mobility - encouraging personal mobility between academia, industry and research institutes. Exchange programmes are in operation between the three.

5. Internationalisation - using international intelligence, establishing policy and frameworks, and a European network for advanced manufacturing. As well as assessing the EU impact and analysing global attitudes, links are being established with the USA, Germany, India, Japan, Singapore and South Korea.

The key drivers for Produktion2030 are sustainability and digitisation. Areas of focus within these headings are resource efficient production, flexible production, virtual production, humans in the production process, circular production and maintenance, and integrated product and production development.

Project examples include re-manufacturing using digital technology and so reducing waste, production simulation, flexible automation in SMEs, virtual modelling of large-scale welding, and new business models for manufacturing. **Digitisation is the main toolbox for these new production solutions.**

Looking ahead, Produktion2030 has secured funding until 2023. It will continue to focus on the key areas of sustainability and digitisation and increase international collaborations across industry, academia and research.
National Stakeholder Platform for the UK: Overview and Objectives

Tom Egan, Digital Engineering and Manufacturing Leadership Group (DEMLG)

“An industry-led platform to drive and direct the digitisation of UK industry”

The leadership group (DEMLG) is motivated by the huge potential benefits of digital for industry in terms of increased revenue, reduced costs and improved productivity. The leadership group is an industry-led platform to drive and direct the digitisation of UK industry to the benefit of the UK economy.

Its objective on establishment was to create a joined-up approach and a single point of contact, making recommendations to the UK Government regarding delivery of tangible benefits, mobilisation of strategic initiatives with measurable outcomes, monitoring and ensuring progress to deliver impact.

The origins of the group stem from the enormous importance of digital. Regardless of whether it is revolution, evolution or simply an acceleration of change, digital storage, speed and connectivity are top of a global agenda.
Two conferences in the UK in 2015 established a common understanding of the opportunities, the work of pioneers, the desire for knowledge sharing, an acknowledgement of the impact on industry with a recognition that digital was an international issue. The UK could build on strong foundations but to deliver impact there was a need for Government/industry collaboration across sectors.

To date, the leadership group has formed an action group focused on intelligent manufacturing. It contributed to the UK Government Digital Strategy consultation early in 2016, subsequently aligning and integrating with the industry led Productivity Leadership Group established by the UK Government. It engaged with Government both pre and post the EU Referendum in June 2016 and has influenced the National Innovation Plan and emerging Industrial Strategy.

The leadership group is reviewing its terms of reference to make sure that inclusion and engagement is managed, that disparate activities are consolidated for maximum impact and that governance and accountability is firmly established. Sub-level working groups have been set up to cover a variety of issues including business models, implementation, research, skills, work and society, cyber security and legal aspects, and standards and regulation.

The group had the primary initial objective of delivering an implementation proposal to Government ahead of the March 2017 budget. Looking in particular at the aerospace, automotive, healthcare and pharmaceutical, construction and infrastructure, and food and drink sectors, the DEMLG aims to make its impact felt through research projects, demonstrators to stimulate ideas and show the art of the possible, and outreach projects to demystify and develop new skills.

The EPSRC Network Plus project Industrial Systems in the Digital Age (a £600k project running until summer 2019) will bring together key players from manufacturing, digital, design and business communities to build new collaborations between industry and academia. The network will aim to look beyond Industry 4.0 to perspectives on future industrial systems and how digital technologies will impact on them.

In addition, the HVM Catapult is sponsoring and supporting digital manufacturing demonstrators:

### HVM Catapult Digital Manufacturing Demonstrators

<table>
<thead>
<tr>
<th>Demonstrator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory 2050, AMRC</td>
<td>Our revolutionary, “reconfigurable factory”</td>
</tr>
<tr>
<td>Factory in a Box, MTC</td>
<td>Distributed manufacturing and new business models</td>
</tr>
<tr>
<td>Automated Inspection Welding, AFRC</td>
<td>Automated robotic welding of complex components</td>
</tr>
<tr>
<td>Inkjet Flex®, CPI</td>
<td>A fully automated digital R2R Inkjet circuit printing</td>
</tr>
<tr>
<td>Intelligent Automated Composites Processing Cell, NCC</td>
<td>Machine learning to optimise production of composites</td>
</tr>
<tr>
<td>Automation System Workbench, WMG</td>
<td>A modular full-scale multi-purpose R&amp;D and training system</td>
</tr>
<tr>
<td>Digital Twin, Nuclear AMRC</td>
<td>Real time input into a virtual model</td>
</tr>
</tbody>
</table>
The German Federal Ministry for Economic Affairs and Energy is preparing to publish its Digital Strategy 2025, which focuses on developing capabilities and using new tools to make a digitised Germany possible.

A key focus in Germany is on ensuring the successful adoption of Industrie 4.0 principles among SMEs and start-ups, through the establishment of SME 4.0 centres of excellence.

In Sweden, Produktion2030 is taking the lead in ensuring that by 2030, production is sustainable and sufficiently resourced and is making good progress towards that aim with funding secured until 2023.

The Swedish programme focuses on five key strands: projects, SMEs, education, mobility and internationalisation with the key drivers being sustainability and digitisation.

While progress has been made in the UK over the last year - particularly with the establishment of a leadership group - there is still much to do, and many companies still find aspects confusing.

The business model must be changed to include every aspect of the product and production, from development to customer and every process in-between.

The fourth industrial revolution will change every aspect of people’s lives. It will require a digital infrastructure to allow for a free flow of digital information, while protecting data in a common regulatory framework.

All stakeholders should be involved in the process of transformation. This is particularly important for employees. In that respect, skills development is essential.

The specific needs of SMEs should be addressed.

International cooperation is of utmost importance particularly in the field of standardisation.

The leadership group in the UK will aim to work with Government to inspire businesses and stimulate ideas through research projects, outreach projects and demonstrations of the art of the possible.

The UK is cognisant of the global dimensions of the digital landscape and is actively engaging internationally to address challenges, notably in standards and regulation, research, cyber security and legal.

Policy and frameworks for international networking will be central to the formation of a digital global marketplace.
SESSION TWO
Work Environment, Education and Training
Introduction by Alan Norbury, Siemens UK

“Engineers of the future will spend more time in the virtual world than the real world”

For Siemens, the Fourth Industrial Revolution means introducing smart innovations for a competitive edge. These include reduced time to market through shorter innovation cycles for more complex products, enhanced flexibility from individualised production with higher productivity, and increased efficiency of energy and resources.

Siemens is moving towards the factory of the future, using cyber-physical systems, with the physical production unit developed and replicated in a digital model. This model is always up-to-date and is extended over the entire lifecycle of the product. All stages from design to production are tested in the virtual world.

These new concepts in production require different skills to engineer the virtual world. The engineers of the future will spend more time in the virtual world than the real world.

Tim Jones, Siemens ‘Junior Factory’

“You don’t learn if you don’t do”

As former managing director of the Junior Factory at Siemens UK’s Congleton factory, Tim Jones oversaw a complete ‘factory within a factory’, responsible for its own engineering, production, quality, budgets, planning and people management. The Junior Factory, first started in 2010, is staffed entirely by apprentices and graduates as part of their development of traditional skills, but more importantly, skills of the future.

The factory is a supplier to the main factory, initially assembling variable speed drive fan sub-assemblies, and last year supplied 270,000 built assemblies to the production line.

In the process, the trainees built up real world manufacturing skills which are not taught in universities or colleges. They also learned the importance of their responsibility as part of the supply chain. You don’t learn if you don’t do.
They also worked on lean cell design, firstly doing it in a traditional way by building a physical prototype. They then moved to virtual simulation, modelling and improving the entire work cell.

As well as skills development, Siemens gains from the Junior Factory in terms of cost, logistics and productivity. The business was able to in-source 13 different assemblies, responding instantly to customer demand with a reduced carbon footprint.

The Junior Factory will now build on its capabilities with more simulation and 3D modelling, using smart devices and reducing operator complexity. The result will be an ability to customise design for any customer, to integrate intelligent tools into the system, provide live information for the supply chain and live stock reporting.

For Industry 4.0 to bring real business value, the engineers of the future will need hybrid skills, a combination of traditional engineering skills combined with IT and creative virtualisation skills. Multi disciplinary groups will work in close knit, globally diverse teams, students with engineering, IT and gaming qualifications working together on industrial projects with common data platforms.
Industry 4.0 will redefine shop floor jobs.
All levels, from the unskilled operator to a Master of Engineering will require new skills.

For the unskilled shop floor operator, wearables and electronic prompt systems will change the nature of their jobs, with production steps displayed on a screen in front of them.

For engineers, technicians and operators who have trained in further education and/or on-the-job training, there will be new skills requirements for Industry 4.0. These will include an understanding of the complete manufacturing process and the technical design of a production line including robotics, communication networks and cloud computing. They will also need diagnostic skills to interpret data, use smart devices and virtual reality, and spot the potential for further automation or innovative technology.

For degree students at Bachelor of Engineering level, they will need the capability to design and engineer a production line with an Industry 4.0 approach and to design and engineer diagnostic systems, understanding which information needs to go to whom and how often, and when a problem needs to be escalated. They will also need to understand how to use data, and data mining.

For postgraduate engineers, they will need to take on the role of Industry 4.0 consultants. They will require the capability to design and engineer entire manufacturing processes, global networks, fast and secure communication and platform software for production performance and quality.
At Bosch Rexroth, Industry 4.0 training is underway both in an academic environment and in the factory. Hands-on learning, e-learning, e-books, theory and animations are all deployed to deliver the training, as well as train-the-trainer development. This applies at all levels from non-technicians to application engineers and covers the company’s factories in Germany and overseas. A complete production training centre has been designed and produced to deliver a wide range of production skills training, incorporating robotics, CNC, smart devices, office tools, web-based visualisation, cloud and communication.
A UK View on the Societal Challenges of the Fourth Industrial Revolution

Tim Page, TUC Senior Policy Officer

“Technology, in short, creates societal challenges”

Technological change has existed since the first industrial revolution. The history of technological change has been one of massive potential and great fear. Evidence shows that technological change is a net job creator. However, people losing the old jobs are not necessarily best placed to get the new jobs, and new industries do not necessarily create the steady, well-paid jobs of old industries. Technology, in short, creates societal challenges.

Among some in the UK there is a perception of a lack of high skill, high value jobs that pay decent wages and provide dignity at work. The days of the UK as the industrial workshop of the world are over, but the UK can create far more good jobs with an intelligent, sustainable industrial strategy, engaging government, businesses and trade unions.

On the positive side, digital manufacturing provides the opportunity to modernise manufacturing, to establish business networks to predict failures, to manage energy use and to provide good jobs and a better work-life balance. On the negative side, according to the World Economic Forum, five million jobs have been lost worldwide. In the US, jobs are at risk of automation in 47 per cent of occupational classifications. What robotics did for blue collar work, artificial intelligence will do for white collar work.

But digital manufacturing need not destroy jobs if new technology and processes are introduced in an intelligent way. This requires strong leadership and focus, and a clear voice for trade unions.

Germany leads the way. At this conference last year Henning Banthien, secretary general of Germany’s Platform Industrie 4.0, said, “Industrie 4.0 must be understood as a project of, and for, society as a whole, and it requires a close alliance between the private sector, academia, research, politics and trade unions.” The future labour force must be positively connected to the changes and advantages resulting from Industrie 4.0.

We should understand the value of the pause. When you hit the pause button on a machine, the action stops. When humans pause, true reflective work begins. Workers must be as empowered as possible, including having the power to pause.
Skills

- According to the World Economic Forum, World Bank and the International Labour Organisation, a radical change in the division of labour along global supply chains will change the skills demands of employees.
- Cognitive, social and problem-solving skills are more in demand.
- Those are human skills that a robot would struggle to emulate.
- Workers will need skills necessary to cope with and shape digitalisation process.
- They will need to exploit new opportunities of learning through information technologies.
- Workers who can choose employers who recognise them as a whole person, not just a unit of labour.

The UK Commission for Employment and Skills has acknowledged the positive benefits of the high performance workplace, in which employee involvement and commitment is stimulated to achieve high levels of performance. High performance workplaces are associated with increased profits and sales. Employees report higher job satisfaction, motivation, involvement, commitment and greater opportunities for innovation and creativity, alongside lower staff turnover.

High Performance Workplaces

“a general approach to managing organisations that aims to stimulate more effective employee involvement and commitment in order to achieve high levels of performance. [They are] designed to enhance the discretionary effort employees put into their work, and to fully utilise ... the skills that they possess.”

UK Commission for Employment and Skills

- HPWs are associated with increased profits, sales and profitability.
- Employees report higher job satisfaction, motivation, involvement, commitment, and greater opportunities for innovation and creativity, alongside lower staff turnover.

Few firms adopt high performance work systems. This is through lack of knowledge rather than hostility. A UK Government report recognised that several European countries require employee involvement, such as works councils, but a statutory approach ‘doesn’t fit with existing UK policy frameworks’ and there is no appetite among businesses. However, it is gratifying that Theresa May is interested in industrial policy, including workers on company boards.

Industry 4.0 is the next stage of industrial transformation, and in a century set to be dominated by dynamic Asia, European industry cannot stand still. But we must put people at the heart of this process, The German engineering union IG Metall is leading the work group Work 4.0 and is looking at: job security and fair remuneration, reduction of workload and revaluation of activities, better professional development and learning opportunities, more time sovereignty and self-determination, and involvement and participation on an equal footing.
Summary:
Session Two

• Engineers of the future will spend more time in the virtual world than the real world. There will be a requirement for skilled developers, and engineers with the capability to convert big data into data for the business, with secure and easy connectivity and use of the cloud.

• Siemens’ Junior Factory provides real world manufacturing experience for young talent, including responsibilities for supply chain, planning and budgeting, and people management. It is providing ‘learning by doing’.

• The fourth industrial revolution is redefining shop floor jobs. All levels, from the unskilled operator to senior engineers will require new skills.

• Bosch Rexroth is taking a leading role in the development of Industry 4.0 training courses both in an academic environment and in the factory - from hands-on learning, e-learning and train-the-trainer sessions, to a complete production training centre that delivers production skills training incorporating robotics, CNC, smart devices and web-based visualisation.

• Digital manufacturing provides the opportunity to modernise manufacturing, to establish business networks to predict failures, to manage energy use and to provide good jobs and a better work-life balance, but all stakeholders must be involved in the process.

• Industry 4.0 is the next stage of industrial transformation, which is crucial to ensuring European industry keeps up in an increasingly competitive global marketplace. But it is important to put people at the heart of the process.
PARALLEL SESSIONS
Martin Kelman, Senior MOM Consultant, ATS

Martin Kelman, of independent manufacturing solution provider ATS, gave a practical example of bridging the gap between shop floor and application systems and an IT network, so achieving a manufacturing network ready for Industry 4.0.

The aim was to produce end-to-end engineering across the entire value chain, with open, closed and shared data flowing throughout production and the product itself from the manufacturing equipment, through the manufacturing process and associated operations and through the extended supply chain.

To begin with, every stage can be virtualised, including the plant model, required machine connections and the manufacturing operations. These can now be simulated through the manufacturing process prior to realising the production using appropriate technologies, which may include flexible assembly, dynamic location awareness, advanced robotics, big data integration, human-machine collaboration and remote monitoring.

The production process, and the data produced at every stage, can then be analysed in order to improve it and ensure proper maintenance schedules. All of this information flows horizontally through the entire extended supply chain, so ensuring a complete digital thread for each product with the complete integration of every step.
Discrete Industry Issues – Bottom up top down

- Enterprise
- Finances
- Transactional
- User Interface – Database Centric
- Event Driven
- Real Time Visualisation
- Warning and Alarms
- Real Time User Interface
- Program Scripts
- Real Time Control
  - Inputs
  - Process
  - Outputs
- Real Time Program Scan

ATS Bus 2.0

The development of the ATS Bus has enabled us to create industry 4.0 demonstrator platforms by allowing the integration of different technologies that previously either required bespoke interfaces creating each time a different technology was connected or the solution had to become a single vendor solution due to the large number of protocols used in manufacturing combined with a lack of interoperability.
Martin Dury led delegates on a tour of the MTC’s Advanced Manufacturing Training Centre, which opened in 2015. The training centre is home to a broad range of state-of-the-art equipment and machinery designed to develop the vital skills and experience required by the next generation of engineers and technicians. This includes: DMG MORI CNC machines, Bosch Rexroth intelligent automation, hydraulics and pneumatics, AMM (IRCS) robots, PLCs, co-ordinate measurement machines, Hexagon Metrology equipment and Hexagon PC DMIS, GOM systems, 3D scanning and more.

The MTC’s apprenticeship programme provides unique, flexible career paths into manufacturing engineering, providing training in basic engineering skills and principles, through to advanced manufacturing techniques. It provides a unique opportunity for the best young talent to develop the knowledge and expertise required to build a career in an exciting, thriving and innovative environment.

‘Our training courses are setting the standard as the future of advanced manufacturing apprenticeships. The unique opportunity to gain expertise with MTC member companies involved in some of the most exciting research into advanced manufacturing methods and processes being undertaken anywhere in the world, provides a great springboard to an exciting career in a thriving sector.’ Paul Rowlett, Managing Director, MTC Advanced Manufacturing Training Centre.
Third year apprentice, Rishi Chohan shows delegates the digital manufacturing training facilities at the MTC’s new training centre.

Delegates were also given a tour of the state-of-the-art Bosch Rexroth training room.
How can Digital Manufacturing be delivered in SMEs and MidCaps?

Lina Huertas, Head of Technology Strategy for Digital Engineering, MTC

“There are several barriers to digitisation, but there is help available”

In the UK SMEs represent more than 99 per cent of all private sector businesses, 59 per cent of private sector employment and 48 per cent of private sector turnover.

Among this group there are several barriers to digitisation. These include a lack of information and awareness, a lack of investment capacity and expertise, as well as a lack of fit or adoption and a lack of time.

Lack of information and awareness can be tackled through a thorough, bottom up digital diagnosis and audit of the kind offered by the MTC. This will identify quick wins to get employee buy-in and energise the workforce. It will also identify strategic opportunities.

Adopted from: Overcoming Barriers to Technology Adoption in Small Manufacturing Enterprises (SMEs), Carnegie Mellon, 2003
Developing e-infrastructure in the UK's Engineering and Manufacturing Industries, E-Science Leadership Council, 2012
Lack of investment capacity can be addressed by simulating the business case. Properly presented this can unlock funding on a national or European level. Sources of funding may include the High Value Manufacturing (HVM) Catapult centres, Innovate UK or the EU's Horizon 2020 framework programme for research and innovation.

Lack of fit or adoption may have more to do with selecting the right technology. Benchmarking will help with this, and there are digital technology demonstrators available around the country where technology can be tested, improved and benefits assessed.

There is also plenty of help available to tackle lack of expertise. The HVM Catapult centres can offer services, as well as offer training to improve internal skilled resources and advise on apprentice skill sets.
Success Story:
Implementation through an Industry Cluster Approach – ‘it’s OWL’ (Intelligent Technical Systems OstWestfalenLippe)

Martin Rabe, Senior Project Manager, ‘it’s OWL’

“A flagship high-tech strategy”

‘it’s OWL’ is an acronym given to Intelligent Technical Systems OstWestfalenLippe - an industry cluster in the north west of Germany.

The cluster has come together to focus on production. Sponsored by the Federal Ministry of Education and Research, the cluster approach is the flagship of the high-tech strategy of the German government. It represents a regional pooling of economy and science with the objective of taking a lead in intelligent technical systems, so securing jobs and creating new jobs.

There are 15 leading edge high-tech clusters operating in Germany, each receiving 40 million euros of funding over five years. The industry within the cluster has to put at least the same amount into the project. In the case of ‘it’s OWL’, it means a project volume of 100 million euros. Other clusters include aviation, efficiency and logistics, software, biotech, medical and the bio-economy.

Key Objective it’s OWL 2017:
Top Position in Intelligent Technical Systems

Systems at the Service of Humanity:
- Resource efficiency
- Usability
- Reliability

Further objectives:
- 80,000 jobs secured
- 10,000 new jobs
- 50 new companies
- 5 new research institutes
- 500 additional researchers
- 4 new courses of study / 500 enrollments (p.a.)
The aim of the ‘it’s OWL’ cluster is to provide access to intelligent systems development for SMEs as well as larger family owned companies. Larger companies are working with research organisations to develop innovation projects which facilitate transfer of the technology to SMEs.

There are currently five platform projects, which built the technology platform of intelligent technical systems and for all other projects within the cluster. The platform projects focus on: self optimisation, human and machine interaction, intelligent networking, energy efficiency and systems engineering.

There are 33 innovation projects and 170 transfer projects, each involving one company and at least one research organisation. The transfer projects are especially suited to SMEs, which do not have the capacity for large R&D projects. One effect of the cluster is that there is 264 scientists and researchers in the region. Six new research facilities have been set up. Of the 170 transfer projects, 73 have been completed. A further 40 will start in 2017.

Each technology transfer project begins with gathering information through presentations at fairs and involvement of regional networks. This is followed by the gaining of a deeper understanding of the issues through task forces, best practice examples and trade journals. The testing stage is next, using one of several demonstration centres and company visits to see practical testing and try-out. Finally, the application and integration stage, using co-operative projects between companies and research institutes with funding in place and solutions realised.

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**Success factors of it’s OWL**

**Entrepreneurship**

In family-owned businesses the managing directors think long-term and assume the risk.

**Strategic Competence**

The strategic leadership is based on strategic foresight, a distinct strategy and an ongoing strategic controlling to meet the challenges of tomorrow.

**Systems-Engineering-Competence**

Innovative products and services are the results of the interaction of different disciplines. This requires system thinking and an interdisciplinary product development.

**Cultural Affinity**

Companies and research facilities pull together for their common goals.

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The cluster results are extensively communicated to industry and politicians using fairs, conferences, political visits as well as the press and media. The success factors of the cluster are shown above. One important factor is often forgotten, but plays a crucial role at ‘it’s OWL’: It is not all about technology by itself. It is also about how to develop innovative products and services that consist of the combination of different technologies. This requires new methods and approaches of product and service development that we call systems engineering.
UK Success Story:
Engineering and Business Integration at Hayward Tyler

Tom Bolton and Oliver Buhlinger, Hayward Tyler

“None of this matters if people are not on board”

Hayward Tyler is a 200 year-old company involved in the design and manufacture of electric motors, pumps and turbines for the global energy sector. It employs more than 500 people at three bases in the UK and at facilities in the US, China and India.

It is a people-centred organisation working on the principles of pride, innovation, pace and excellence. It recognises that it is essential to keep moving forward, but none of that matters if people are not on board.

In 2011 the company acknowledged that its factories and its manufacturing processes were ageing, and as a result the business was in a precarious position. The decision was made to streamline the factory and manufacturing processes along lean principles. All members of staff were involved in this improvement project, with top-to-bottom, hands-on engagement.

Building the Future Factory

We educated ourselves on our processes

We demolished the old

We trained together

We built the future factory
Old facilities were demolished and construction of the future factory began. All staff were trained in new processes, and everyone was engaged in the new ways of working.

A new, digitised visual management information system was built, accessible to all. This included live sales information, customer service, logistics, finance, project management, throughput control, analysis tools, ‘what if’ scenario simulation, health and safety, CI, quality and training, with a supplier portal.

Computer-aided engineering systems were supported with 3D printing and cloud data storage. Design automation allowed rapid responses to customer enquiries, a reduction in repetitive tasks and scalable solutions to bridge the gap between engineering and sales.

Recruiting and developing the brightest and best people available, Hayward Tyler now had a smart factory staffed by smart people. More than 47,000 hours of employee training has been carried out and the business now has an 89 per cent apprentice retention rate and 75 per cent of the company’s graduates are promoted within three years. Smart ‘Crusers®’ were developed to move parts and products around the factory, equipped with tablet computers, wireless control and location detection technology. These improved safety, reduced crane lifts, eliminated fork lift trucks and reduced cycle times with rapid tool changeovers.

The benefits of the changes made and digitisation introduced have included significant improvements in on-time delivery, lead time reduced by half, aftermarket parts lead time reduced from 19 weeks to nine weeks, cost avoidance of half a million pounds through simulation and Crusers®, improved business intelligence and major order wins as a direct result of simulation and virtual reality.
• Barriers to implementation can be tackled through a thorough, bottom up digital diagnosis and audit of the kind offered by the MTC and the High Value Manufacturing Catapult. This will identify quick wins to get employee buy-in and energise the workforce. It will also identify strategic opportunities.

• Flagship development projects must be effectively communicated to the wider industry community in order to lead by example.

• An industry cluster approach, such as the Intelligent Technical Systems OstWestfalenLippe (it’s OWL) in Germany, is an example of how a regional pooling of funding and science can push forward the development and adoption of intelligent technical systems, especially in SMEs and small businesses, helping to secure jobs and create new ones.

• UK examples of digitisation, such as Hayward Tyler, have shown that it is essential to have staff engaged and involved in the move toward a more digitised organisation.

• All members of staff must be involved in improvement projects, with top-to-bottom, hands-on engagement. All staff should be trained in new processes, and everyone engaged in the new ways of working.

• With staff engaged, significant opportunities and benefits can be realised from improvement projects – ranging from reductions in lead time, cost savings, improved business intelligence to improvements in health and safety.
SESSION FOUR
Standardisation and Reference Architectures
Standards have a key role in support of innovation. High value collaboration in the field of standards presents an international opportunity for the UK. Organisations need standards covering products, processes, and potential future developments. In the future, standards are likely to concentrate more on behaviour, principles and values, and people.

As an example, a partnership between the BSI and the Future Cities Catapult has resulted in the Future Cities Standards Institute. This will enable cities – particularly new and growing cities in developing countries – to benchmark themselves and improve their own standards. This is an opportunity to export UK expertise.

BSI and its partners are now developing standards to support digital manufacturing and the development of smart factories. There is a clear need for initiatives and standards to encourage collaboration and sharing. This is key to UK success in digital manufacturing. The standards needed to accelerate innovation in digital manufacturing cover the interoperability of data and machines, using data in a manufacturing context, governance in a digital environment, the performance assurance of digital twins and collaboration, as behaviour moves away from transactional relationships towards more sharing of data.
New approach to handling complex issues – Smart Cities

- Partnership between BSI and Future Cities Catapult – Cities Standards Institute.

- Builds on:
  - PAS 190 smart cities terminology
  - PAS 181 smart cities framework
  - PAS 182 smart cities data concept model
  - PD 8101 planning of future city developments
  - PD 8100 Overview of smart cities

11/07/2017

Definition of Digital Manufacturing: e-Enablement of value chain optimisation

- Digital manufacturing is the **collaborative** transformation of manufacturing through the exploitation of advances in ICT.

- Digital manufacturing transformation enables new supply chain and operations capabilities (scenarios) to emerge that exploit advances in digital technologies, devices, data analytics, data integration and management across the value chain in many sectors.

- Digital manufacturing requires the development of new systems engineering competencies (systems modeling, simulation and interface design) and skills (attitudes) across the manufacturing value chain (R&D, design, supply, production, distribution, in service, disposal).

- Digital manufacturing offers significant national and corporate competitive advantage through affordable flexibility, personalisation and product/service tailoring.

Initial view of standards to accelerate innovation in digital manufacturing

- **Interoperability of data and machines.** Establish what data are recorded and in what format (e.g. RAMI4.0, ISO Smart Manufacturing SAG, IEC 580).

- **Using data in a manufacturing context.** Engineering decisions (relating to e.g. product quality, supply chain optimisation & resilience, asset maintenance, design) will be made based on wide range of fast-moving data. Each actor in the supply chain needs to be aware of how these data are being used, and for what purpose, and therefore what needs to be done.

- **Governance in a digital environment.** How do we make decisions based on other data? Are the data secure enough and reliable, and is ownership clear? What does the company need to do to manage risks from using data? May require a common “decision making framework” across supply chains.

- **Performance assurance of ‘digital’ twins.** Real, physical systems will be made using virtual modelling capabilities. For these to be widely adopted and exploited there needs to be confidence in their results – assurance.

- **Collaboration.** Digital innovation in manufacturing is driving behaviour away from transactional relationships towards more collaboration. All actors need to understand the basis of the collaboration, have common expectations, and what their obligations are in the partnership (e.g. BS 11000).

- **Others.** Obsolescence management, design for “X”, management systems in a flexible manufacturing context.
To ensure consistent communication a common language is being developed

To support its Industry 4.0 programme, Germany has established a group to develop standards and architecture for digital manufacture. Called RAMI 4.0 it is looking at digital business processes, functions, data, communication and integration as well as the real world of things. It has drawn up a reference model to cover the life cycle of products from development to sales and service.
The model covers all aspects of value streams and value networks, looking at the product, the factory and the supplier network. In particular it examines interaction and exchange between all stages, whether it is physical communication or machines talking to each other. To ensure consistent communication, a common language is being developed with its own symbols, alphabet, vocabulary, syntax, grammar, semantics and culture.

The old world of manufacturing used hierarchy-based communication, usually hardware-based, which tied functions to the hardware and isolated the product. The new world of smart products, smart factory and a connected world requires flexible systems with communication among all participants throughout the network and across hierarchical levels. The product is part of the network. Effectively, an administrative ‘shell’ is built around the entire network, connecting the product to the process, storing all data and information, serving as the network’s communication interface and integrating passive components into the networks. Each product has its administrative shell to be integrated into the Industry 4.0 network. The first open source prototype of this was completed in September.

The architecture under development is being benchmarked against other countries including the US and China. The IIC in the US is not just looking at smart manufacturing, but also smart home/building, healthcare, mobility and smart grid. China has developed a system architecture which is similar to the RAMI model. RAMI has signed a co-operation agreement with counterparts in China to share results. This, and other international co-operations and networks, will go some way to addressing the need for worldwide standards for each area of technology.
Stefan Hoppe, Vice President, OPC Foundation and OPC Board Member

“...more than just a protocol”

The OPC Foundation is an international body aimed at achieving global secure, reliable, multi-vendor, multi-platform, multi-domain interoperability for everything from sensors to whole enterprises. It has bases in Germany, the US, China and Japan. Its board is made up of representatives of automation and IT companies from all over the world.

Currently, although there is connectivity, there is a lack of interoperability. The OPC proposition enables secure and reliable international interoperability that is scalable from sensor to cloud, and independent. It offers a unified architecture which is client friendly and to IEC62541 standard. Licensed members have access to developer tools to speed up implementation and testing. It has been security analysed and is recommended by the German Industrie 4.0. It conforms to American and Chinese national standards.

Value Prop - Summary

› Secure and Reliable

› International
  ◦ Organization: 437 members worldwide – 216 in Europe
  ◦ Specification: OPC-UA is IEC62541

› Scalable: From Sensor to Cloud

› Modelling data and interfaces plus access rights

› Independent
  ◦ Vendor / OS platform / Language / Domain

› Transport: Multiple options – extendable!
  ◦ TCP / HTTP / UDP / AMQP / ….MQTT / …. ? (TSN)
The OPC UA Unified Architecture is more than just a protocol. It can be used for data modelling, communication, collaboration and new applications, integrating systems and mechanisms. It has proved successful across industries, but in particular for device communication used in water treatment, and energy monitoring from a sensor to an IT cloud.

**Summary OPC UA**

**OPC Unified Architecture is much more than just a protocol**

**Data Modeling**
- Generic object oriented modeling
- Objects with variables, methods and events
- Extensible type system
- History for data and events
- State machines, programs, alarms & condition
- Complex data

**Communication**
- Integrated security mechanisms
- High speed UA TCP protocol
- Web services for internet
- Platform independent
- Built in robustness and fault tolerance
- Redundancy

**Collaboration**
- UA is IEC standard
- UA is base for other information models
- EDDL and FDT
- MIMOSA
- OMAC
- PLCopen

**New Applications and use cases**
- Profiles for different use cases
- Scalability
- Integration in embedded systems
- MES and ERP systems
- Specialized versions for different industries

**OPC Foundation**

- **Vision**
  secure, reliable, multi-vendor, multi-platform, multi domain interoperability from sensor to enterprise

- **International**
  - Companies from Automation & IT
  - International standard IEC62541

- OPC Foundation
  Scottsdale, Arizona

- OPC Asia
  China

- OPC Europe
  Verl, Germany

- OPC Japan
  Musashino-shi, Tokyo
Approach to Standardisation from a UK Perspective

Steve Bramley, GAMBICA

“Post-Brexit there will be no change to the standards process”

GAMBICA represents the instrumentation, control, automation and laboratory technology industries in the UK. It has more than 200 members. It is involved in market data and analysis, standards and regulation, influencing Government policy and lobbying on the industry’s behalf, and communicating via media and conferences.

Standards are a high priority for the electro-technical industry and GAMBICA’s experts sit on more than 100 technical committees. When GAMBICA’s members were surveyed on the UK’s negotiating position following the Brexit vote, influence on standards used in the marketplace was their third highest priority, behind only access to the single market and access to skilled workers. Post-Brexit there will be no change to the standards process.
The UK is involved in international standards processes through strategic advisory groups, using defined reference models and gap analysis. Standards are important to UK industry but it is important that they are harmonised across Europe and the world. In the meantime, UK industry will continue to be active in international standards.
• Standards have a key role in support of innovation. High value collaboration in the field of standards presents an international opportunity for the UK.

• The BSI and its partners are developing standards to support digital manufacturing and the development of smart factories. Initiatives and standards to encourage collaboration and sharing will be key to UK success in digital manufacturing.

• Standards should cover areas such as the interoperability of data and machines, using data in a manufacturing context, governance in a digital environment, the performance assurance of digital twins and collaboration.

• To support its Industry 4.0 programme, Germany has established a group to develop standards and architecture for digital manufacture called RAMI 4.0. This group has drawn up a reference model to cover the lifecycle of products from development through to sales and service.

• The new world of smart products, smart factory and a connected world requires flexible systems with communication among all participants throughout the network and across hierarchical levels.

• The OPC Foundation is an international body aimed at achieving global secure, reliable, multi-vendor, multi-platform, multi-domain interoperability for everything from sensors to whole enterprises. The OPC proposition enables secure and reliable international interoperability which is scalable from sensor to cloud, and independent.

• A unified architecture can be used for data modelling, communication, collaboration and new applications, integrating systems and mechanisms. It has proved successful across industries, but in particular for device communication and communication to an IT cloud.

• Standards are a high priority and they must be harmonised across Europe and beyond. Post-Brexit there will be no change to the standards process and UK industry will continue to be active in international standards.
Ken Young,  
Technology Director, MTC

“Industry 4.0 is an opportunity, not a threat”

Ken Young said it was clear that progress had been made since last year’s conference at the MTC. Following this year’s presentations, several things had become clear:

• The Fourth Industrial Revolution is going to impact everybody. There is no escape whether you ignore it or not.
• It is all about linking supply chains and supply networks beyond the boundaries of our own factories.
• There has been an increase yet again in the pace of innovation. It was getting quicker with an increase in the rate of increase of the rate of increase!
• Germany is making significant investments in connectivity. Getting everyone connected to super-fast internet and investment in 5G will have a big impact. The UK can learn lessons here.
• Most people see Industry 4.0 as an opportunity, not a threat.
• It is all about people. Educating them, making skills available to them, and making them part of the process. Industry must take its people on the journey, empowering them, ensuring they don’t see progress as a threat to jobs, and energise young people in particular.
• Implementation is not so much about research as using technology that is available now.

“We have moved forward further than I thought. But the pace of change can only accelerate.”
**ATS and Industry 4.0**

Unlike political revolutions, industrial revolutions take place over decades and you may not even realise you’re part of it until it’s already in full flow.

Rather than simply watching the developments from the side lines, ATS has made a conscious decision to be part of this industrial revolution by leading developments in the field of manufacturing data collection, transmission, reporting and analysis. As part of this drive the ATS ADOS Software Suite has been developed.

**Increased data crossover**

ATS ADOS is about opening borders so that the data collected by one application can be utilised by all the others. Our team will look for the potential value in your data beyond the use for which it was initially collected. In many cases the lines between attribute, dimensional and operational can be crossed over quite freely. Working with ATS ADOS your data will tell you more than you ever thought it could.

**Strong than the sum of the parts**

When used together, the applications within the suite are able to collect and analyse any data type gathered from any number of operations and transfer the processed information to wherever it is needed.

The unique proposition of ATS ADOS is that it will analyse your production data and map it across the value chain to determine the best fit to optimise production operations.

**Main functionalities**

- Data collection – attribute, dimensional and operational.
- Quality management – visual inspection, option content check and dimensional validation.
- Analysis and reporting – KPV’s, OEE, Energy, Sensors, PLC’s, SPC.
- PLM/ERP/MES and MOM interactions.
- Shop floor OPC and XML server interactions.

**Simplified data delivery**

ATS ADOS contains ATS Bus which acts as a standardised channel through which all data can be exchanged. Not only will it ensure that the data reaches its destination in the safely and correctly but it will also provide a central management and monitoring system for all data communications between ATS software, other software, PLM/ERP/MES/MOM and factory floor data servers.

**ATS ADOS Awards**

Thanks to the pioneering nature of the ATS ADOS software suite the TechniShow jury awarded it the status of INNOVATOR at the TechniShow Innovation Awards 2016. The ATS ADOS suite was also awarded Frost & Sullivan’s 2014 Global Plant Data Management and Quality Optimization Solutions for Discrete Industries New Product innovation Award.

www.ats-global.com
Andy Minturn, Bosch Rexroth

While Industry 4.0 has been theoretically possible for some time now, the last year or two in particular have seen its adoption become truly practical and achievable for many companies, driven by several factors.

The internet is now more widely available globally than ever, via technologies such as Local Area Networks (LANs), wireless LANs, and GSM/LTE networks. Meanwhile, software and hardware affordability and usability has increased markedly, and worldwide GPS localisation is achievable to accuracies down to a few metres. Computing power (CPUs) and data storage options are also much more economic and almost unlimited thanks to the Cloud.

While these are important contributory factors, some other highly significant developments are set to rapidly accelerate Industry 4.0 adoption.

These include integrated, interactive digital communications platforms, such as ActiveCockpit from Rexroth, which process and visualise manufacturing data in real time. These enable a major step towards the truly paperless shop floor, providing real-time production data and enabling well-informed, efficient team meetings reaching rapid decisions based on complete, relevant, readily understandable data. Able to access and display information on process conditions, KPIs and quality, to name a few, these systems are connectible to manufacturing execution systems (MESs), databases and ERP systems, and boast moderation, escalation and whiteboard functions.

A second key area is the broader availability of technologies, allowing truly cabinet-free operation, saving space, while reducing installation and set-up times and cutting wiring costs. These include PLC systems with standardised functionality and open connectivity, enabling, for example, connection via Bluetooth to a condition monitoring application on a smart device.

Meanwhile, specialist Industry 4.0 connectors, such as data acquisition and transmission devices, can simply be bolted on to existing equipment to gather real-time information and transfer it to the Cloud in an easily configurable and manageable format. This frequently removes the need to redesign equipment or purchase new plant, with no programming typically required. This is particularly important given that many plants starting operation now were originally designed up to a decade ago, when the pace of technological development was slower and the possibilities offered by the Internet of Things far less widely understood. However, it is equally applicable to older ‘brownfield’ facilities with minimal connectivity to IT systems.

These connectors, along with sensor packs and upgrade kits using common communications protocols – for functions such as the linking of sensors and actuators into control networks – can go a long way towards creating an Industry 4.0 environment without significant capital expenditure.
Hewlett Packard Enterprise - Industry 4.0 disrupting manufacturing

We're currently facing the Fourth Industrial Revolution. Driven by technology and fed with data, this developing revolution is disrupting manufacturing worldwide, creating opportunities and challenges around efficiency, safety and security. HPE is working with many companies to help realise the benefits.

Digitizing closed-circuit assembly lines

Most assembly lines use equipment from different providers. All of the parts work together, but must be maintained separately. This is complicated and hinders efficiency.

We can digitize your factory components and connect them providing increased visibility to holistically manage the value chain. HPE is working with a global vehicle manufacturer to digitize key manufacturing components, installing sensors on equipment and then connecting all sensor data within a central database in a secure manner.

Digitizing factory environments introduces opportunity for horizontal value chains, which could support unprecedented levels of efficiency and automation by encompassing all of the transactions that comprise industrial activity. For example, imagine if your factory equipment could self-assess and automatically order a needed spare part.

Global competition impacting traditional business models

When facing competitors that can produce goods more cost-effectively, embracing Industry 4.0 brings the opportunity to consider radical new business models, particularly as-a-service offerings.

Kaeser Kompressoren, a leading provider of compressed air equipment, had lost market share to competitors. The company partnered with HPE and SAP on an innovative approach to its challenge: Rather than providing customers with equipment, the company switched to providing the air itself on a pay-per-use basis.

Privacy, security, and safety concerns

As Industry 4.0 forges ahead, industry will face unprecedented new challenges introduced by IoT. Challenges that we should begin discussing now and position to address when they start to manifest.

Today, privacy and security are standard concerns for any business. Once you start digitizing the factory, IT security concerns will include the security of equipment as well as the physical safety of workers. The power of technology can address problems around efficiency. But change also brings challenges, such as privacy, security, and safety. HPE has the solutions help you meet these challenges.

www.hpe.com

BECKHOFF New Automation Technology

Following the introduction of mechanical production systems, work-sharing mass production and the automation of production processes, a Fourth Industrial Revolution is now on the horizon. And the term introduced for this – ‘Industrie 4.0’ – already points toward intelligent, networked systems: previously separated production environments are combined to produce universal production worlds, which are partly of a physical nature, and partly attain a new functionality in the cyber space of web connectivity. The focal point in this development is the convergence of information and automation technology, for which Beckhoff laid the foundation already in 1986 with PC-based Control, and it still offers the optimum control architecture for future Industrie 4.0 concepts.

In order to realise Industrie 4.0 following a genuinely holistic approach, three aspects have to be implemented: horizontal integration across company boundaries, vertical integration through networked production systems, and integrated engineering throughout the product lifecycle. PC control offers the right solution for all of that, especially since it can be adapted very flexibly to varying application requirements: intelligence can be arranged in a hierarchically modular fashion under the central controller, but also decentralised, i.e. with equal rights if necessary. In addition, there are hardly any technical systems today that cannot be operated by PC or at least be connected to a PC via software. Considering the great variety of manufacturing systems and technologies that are used in industrial enterprises, the key role of PC technology as an open platform and defacto industry standard for automation is obvious. The openness and universality of PC Control can also be seen – entirely in the sense of Industrie 4.0 – in current research work for the seamless integration of information areas that until now have been separated. Beckhoff is one of the core companies of the technology network ‘it’s OWL’ (short for intelligent technical systems OstWestfalenLippe) which was distinguished in 2012 by the BMBF as a ‘Leading-Edge Cluster’ and represents the first large-scale project supported in the context of Industrie 4.0. Here, Beckhoff as consortium leader of the innovation project ‘ScaUt’ – one of the three key projects of the leading-edge cluster – is driving the integration of engineering findings into standard automation under the keyword “Scientific Automation”.

www.beckhoff.co.uk
As a leading manufacturer of machines tools, DMG MORI UK LTD are constantly driving the development of machines and researching machine tools for Industry 4.0 in collaboration with our premium partners Schaeffler. As part of the innovative project 'Machine 4.0', 60 additional sensors have been installed on recently developed component parts of a DMC 80 FD duoBLOCK to supply machine data which, using specially developed algorithms, make it possible to make qualified predictions about the machine and processes. This new 'knowledge' will allow us to sustainably improve production processes and ensure that the availability for production equipment can be calculated – a crucial factory in the realisation of cyber-physical production networks.

Within our control system 'CELOS' we have 3 apps:

**CONDITION ANALYSER**
- Serves as a platform for visualising, analysing and predicting machine statuses

**MY MACHINE**
- Visual status at machine level

**REAL-TIME DATA**
- Graphical visualisation of current machine data

www.uk.dmgmori.com

K3 Syspro has over three decades of helping manufacturing companies to achieve cost, time and efficiency savings throughout the supply chain by automating processes and working smarter. With the advent of Industry 4.0, this is now more critical than ever.

As a provider of advanced SYSPRO Enterprise Resource Planning (ERP) solutions, the business has long recognised the potential of best-in-class technologies, to help businesses integrate the value chain, better understand customers, enhance automation, become more responsive, and facilitate a transformation to factories of the future. K3 Syspro has also invested in developing its own tools to integrate SYSPRO and other applications to increase supply chain automation, adding systems integration and data manipulation tool DataSwitch, and HR solution Equator HR to its product portfolio.

By leveraging all that Industry 4.0 has to offer, manufacturers can become more self-sufficient, competitive, profitable, and attractive to customers. And with individual applications able to connect and collaborate with each other, it can also empower people to make faster, more informed decisions to improve existing business processes and add even greater value to customers.

www.k3syspro.com
About the Manufacturing Technology Centre

The Manufacturing Technology Centre (MTC), working in partnership with industry, academia and R&D institutions, develops and proves innovative manufacturing processes and technologies in an agile, low risk environment.

The MTC has been at the forefront of leading the processes to digitise the UK manufacturing sector, or what is fast becoming known as the Fourth Industrial Revolution. It is running a wide research portfolio aimed at helping companies access digital factory technology involving Government and European Commission funds, totalling over £15 million alongside MTC’s own core research funds.

For more information, or to discuss how you can get involved, please visit www.the-mtc.org.

About the UK Science and Innovation Network (SIN)

The UK SIN is jointly funded by the Department for Business, Energy & Industrial Strategy and the Foreign & Commonwealth Office. SIN has 93 staff, based at diplomatic missions in 28 countries and 47 cities around the world. SIN teams work closely with UK stakeholders and partners to achieve the following global objectives:

- Influence science and innovation policies of governments, industry and academia to benefit the UK.
- Improve UK policy based on international experience and emerging opportunities and issues.
- Encourage high level science co-operation to benefit the UK and achieve wider policy objectives.
- Make best use of international technology co-operation and investment to grow UK innovation potential.