



National Manufacturing Debate 2016

25 May 2016



Accelerating Manufacturing Growth

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A white tablecloth-covered table with a white cup of coffee on a saucer. Several brochures are scattered on the table, including one for 'Kontak' and another for 'Kontakt'. The brochures are in various orientations, some showing colorful graphics and others with more text. The background is a plain white wall.

Catalyst for the success of UK manufacturing

Through its work on the manufacturing agenda, UKIP has been instrumental in achieving:

- A record low unemployment rate of 4.4%
- The UK's fastest growing economy in the world
- A record high of 1.5 million new jobs created
- A record high of 1.5 million new jobs created





What is the annual manufacturing debate?

An annual debate launched in 2010 hosted by Cranfield University to provide an independent national forum for supporters of UK-based manufacturing. Stakeholders who attend the debate include manufacturing companies, engineers and scientists, academics, national and local government, finance providers, trade bodies, membership organisations and educational providers.

For the seventh successful year running, this annual event hosted by Cranfield University brought together manufacturing professionals from a range of sectors to discuss and debate

current challenges in the industry. The event encourages networking and collaboration across the sector to enable continued and long-term growth. The topic for 2016 asked “How can UK Manufacturing Growth match the best of the G7?”

Previous National Manufacturing Debates have focused on:

2010: Manufacturing for Energy

2011: Investment, incentives and innovation

2012: Enhancing the supply chain for growth

2013: Does the UK need a manufacturing strategy?

2014: How can the UK improve its manufacturing productivity?

2015: How do we develop the capability for effective reshoring to the UK?



Report

The 7th National Manufacturing Debate was opened by Lord Alec Broers who stated that the UK does not have enough manufacturing, with official figures suggesting that it contributes only 10% to GDP.

He suggested that what manufacturing there is, is very good, but that there is not enough.

He noted that the problems in manufacturing were consistent year-to-year, citing a skills shortage across the spectrum of engineering and manufacturing and insufficient R&D as the major problems.

He suggested that somehow UK manufacturing should be persuaded to spend more on R&D.



The Rt Hon Anna Soubry, Minister for Small Business, Industry and Enterprise, was the first keynote speaker. She stated that manufacturing is important, and that the current crisis in the steel industry showed that lessons needed to be learnt. She added that manufacturing contributes to half of all UK exports and the sector spans 90,000 employers (a figure that some might think conservative). In the last 10 years, UK manufacturing productivity has grown



two-and-a-half times faster than the whole of the UK economy. She further noted that half of the world's large passenger aircraft are flying with wings designed and manufactured in the UK by Airbus, adding that in a recent visit to Northern Ireland, she saw the contribution that Bombardier makes to Airbus. Since 2011 the North East has made more cars than all of Italy, and the UK produces a car every 15 seconds. It has taken the UK around 20-years to get the supply chains working effectively to allow automotive to deliver this exemplary performance.

The emergence of big data, the internet of things, new materials, pioneering flexible manufacturing processes, automation, robotics and additive manufacturing offered the opportunity to further improve performance, "the fourth industrial revolution is beginning and should be exploited" she said. The UK

is a hothouse for innovation and disruptive technology and these strengths position the UK to take advantage of technological changes to provide competitive advantage, recognising recent research at Cranfield to identify a broader grouping of manufacturing businesses. A recent government report on manufacturing metrics advised that the Office for National Statistics should recognise activities both upstream and downstream of production activities in order to better measure manufacturing's total economic contribution.

In order to support UK manufacturing, the government's approach has supported apprenticeship schemes, and digital skills with the launch of the £20m Institute of Coding. This demonstrates the government's support for improving skills for manufacturing, Mrs Soubry said. Noting the importance of small businesses to the economy, she stated that organisations employing 50 people or less contributed to half of manufacturing employment. This reinforces the importance of SMEs to UK manufacturing, but more needs to be done to support this group of companies. Learning lessons from the steel crisis and using this will allow UK government to support growth in UK manufacturing.



"We are determined that we will continue to blast steel at those furnaces in Port Talbot and Scunthorpe"

Anna Soubry MP on energy intensive industries



"If design and support are also grouped with traditional manufacturing measures, an additional £50 billion contribution to manufacturing can be identified."

Professor Rajkumar Roy
Director of Manufacturing at Cranfield University

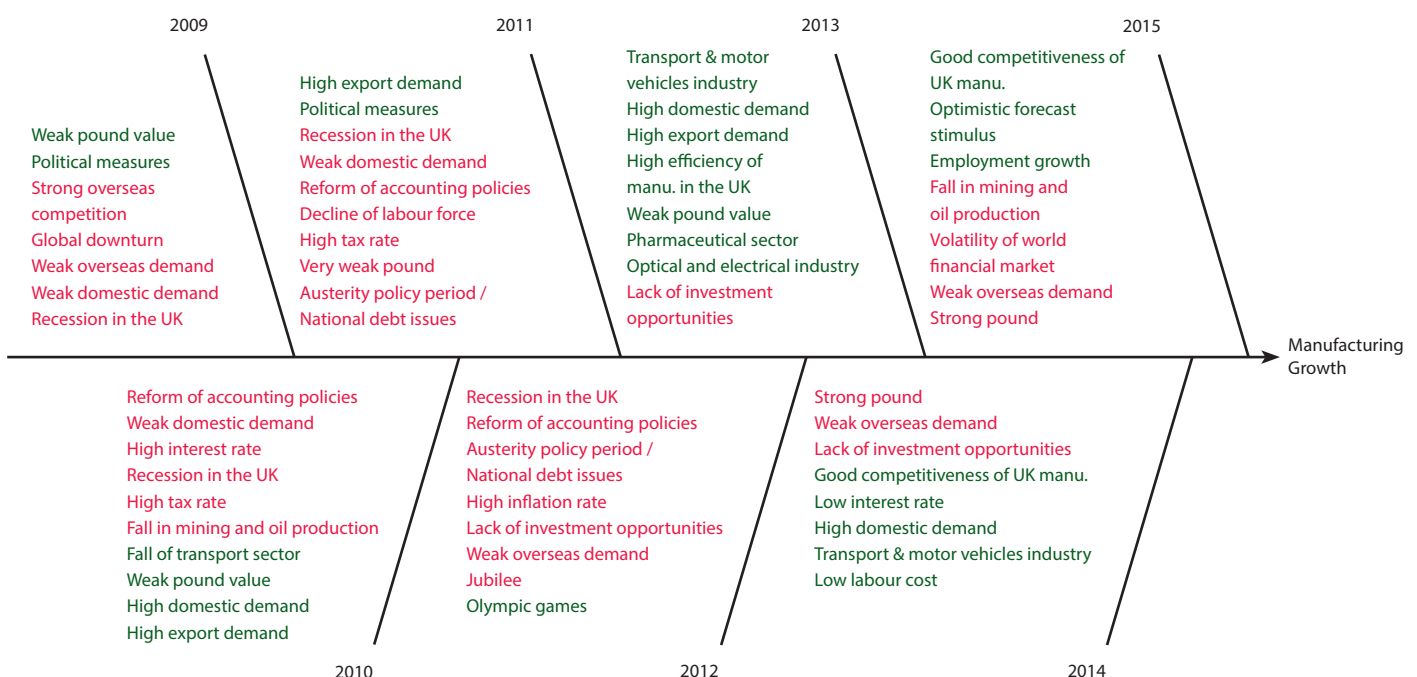
Professor Rajkumar Roy, Director of Manufacturing at Cranfield University, presented some facts about UK manufacturing.

Growth in manufacturing is unstable. Recent research by manufacturing masters students at Cranfield University identified data from the preceding 25-years relating to the growth of UK manufacturing. The research shows that if design and support are also grouped with traditional manufacturing measures, an additional £50 billion contribution to manufacturing GVA can be identified. Prof Roy noted that other larger research projects conducted by the CBI and EEF are broader and included supply chain.

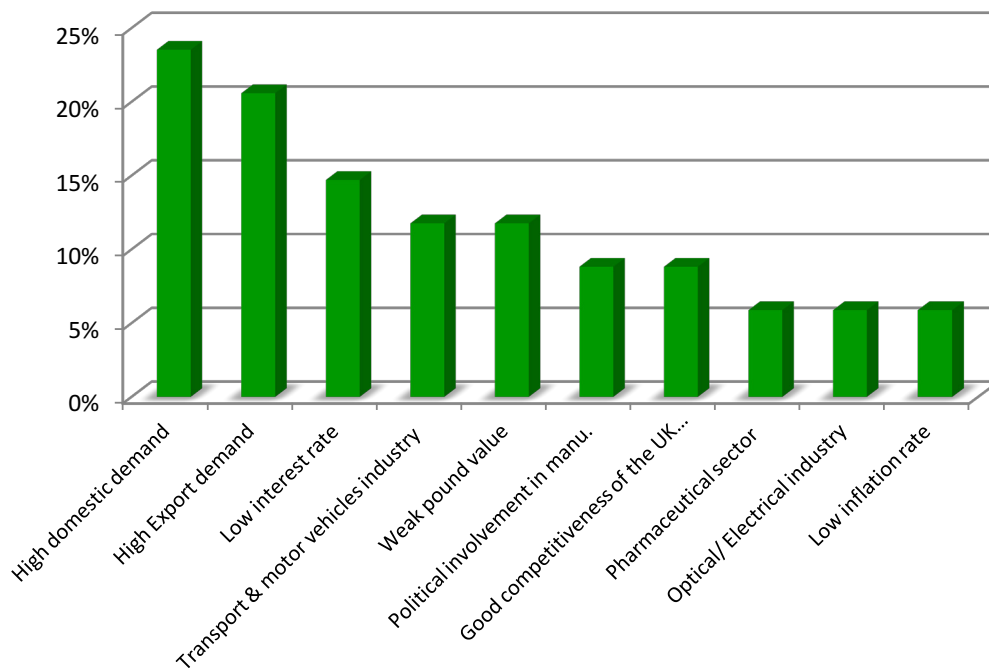
The Cranfield University research has identified that manufacturing's contribution to the UK economy, in this broader definition, is not 10% but closer to 13.5%. 250 articles published over 25-years that referenced manufacturing growth directly were identified and evaluated. Expert judgement from EEF and CBI was used to validate the research findings. Key words were grouped into five year blocks from the early 1990s to date.

Competitiveness of other countries plays a big role.

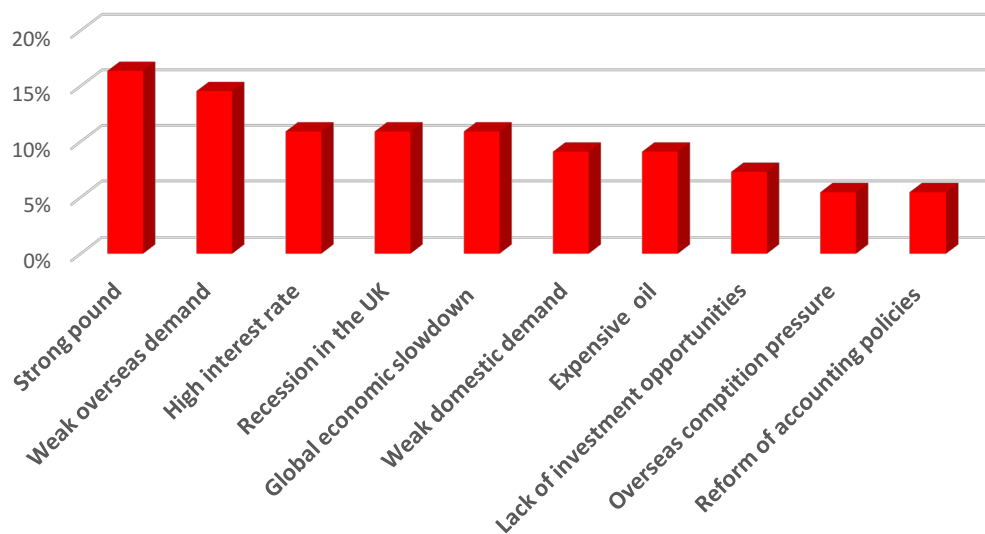
The top three enablers were high domestic demand, high export demand and low interest rates.



Enablers



Inhibitors



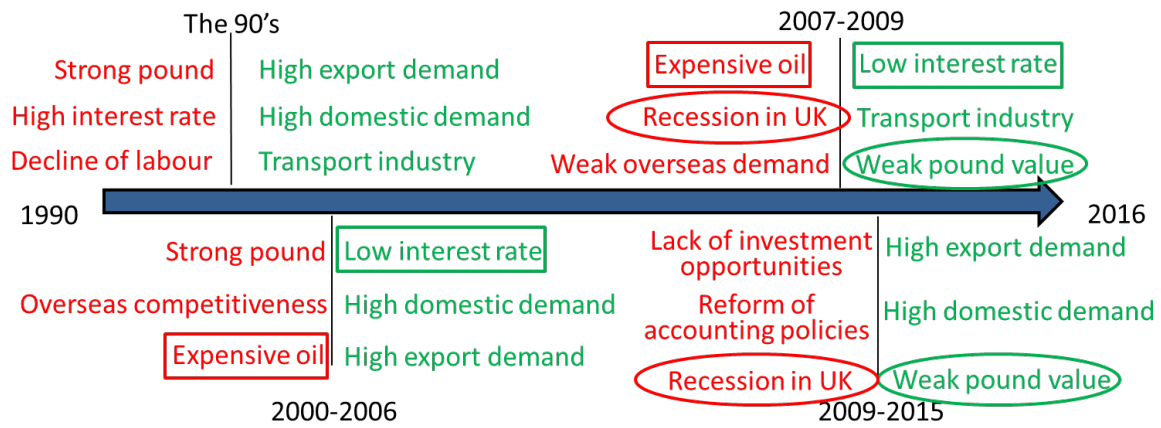
Political involvement in manufacturing is another factor that can be supportive of growth. Government support, for example, with Catapults – the UK's system of technology innovation centres – is an enabler.

The main inhibitors were a strong pound, weak overseas demand and high interest rates. Economic issues are the main inhibitors.

Growth factors over the last 25-years in five-

year blocks show that there are some perennial issues such as demand. Since 2009, lack of investment has been a big factor.

The concept of the extended manufacturing contribution was introduced. Cranfield devised the Extended Manufacturing Growth Index. This adds to the traditional SIC - Standard Industrial Classification – codes for manufacturing. Companies engaged

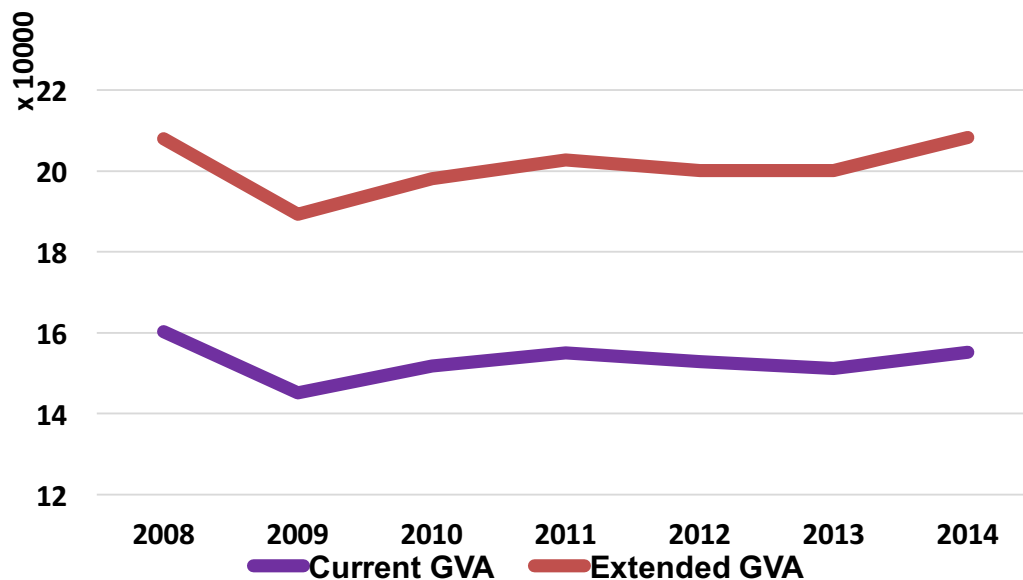


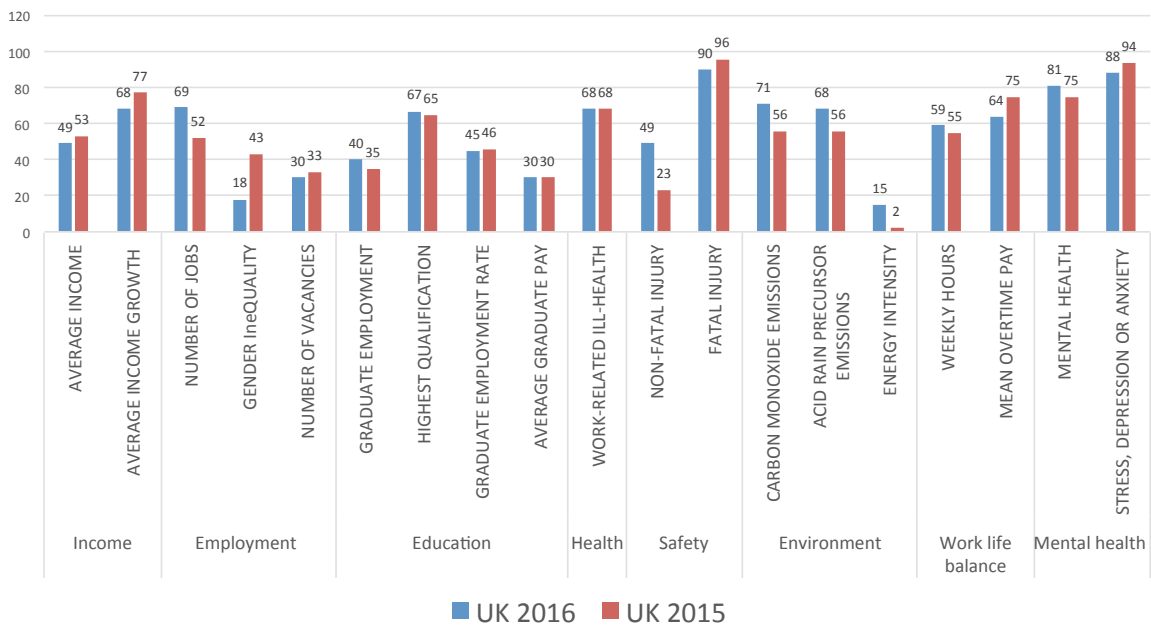
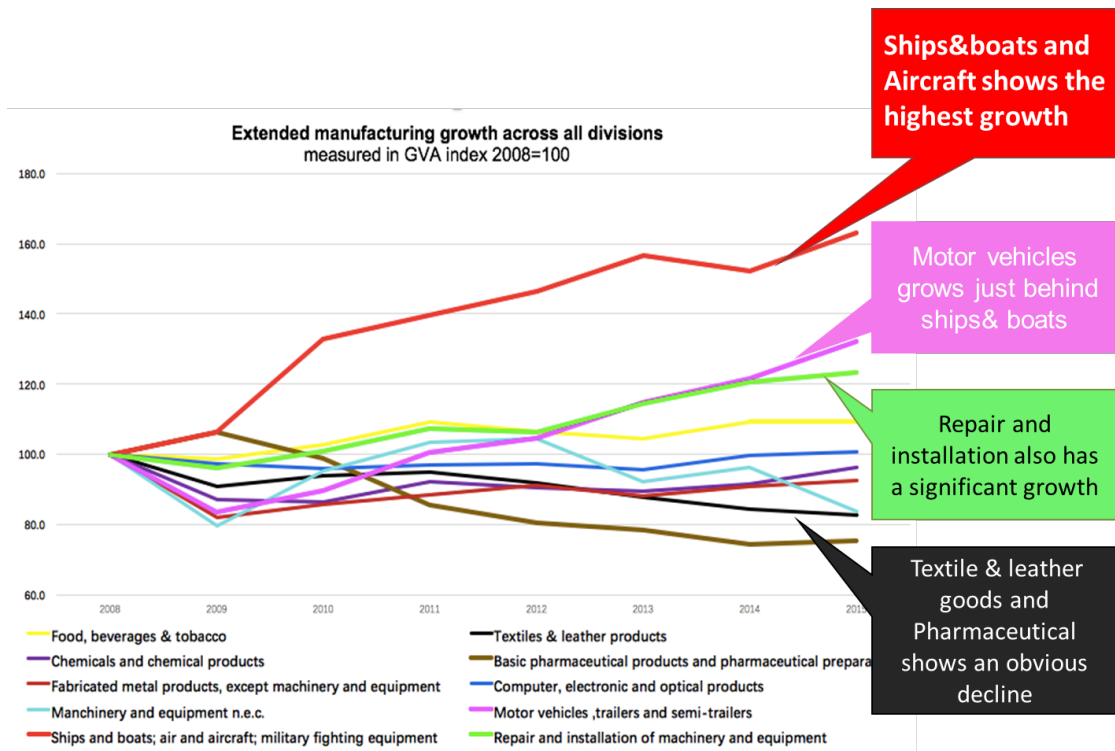
in engineering design, such as ARM, and services, such as Babcock International, are not included in these traditional SIC classification codes for measuring manufacturing GVA. By including design and support, the size of UK manufacturing changes. Other work being undertaken in the UK includes logistics and elements of the supply chain not currently captured, as part of manufacturing. The Cranfield research identified additional codes that could be included and these were validated through expert opinion from the CBI and EEF. Using this extended GVA classification the manufacturing sector can be seen to be worth £208 billion rather than the £155 billion using traditional SIC codes for manufacturing.

The service side of the extended growth index has seen increased growth in recent years (see chart 2013 to 2014).

This overall figure can then be evaluated in a sector specific approach to identify which sectors are growing at which rate. Ships, Boats and Aircraft (as a SIC code) show the highest growth rate, followed by Motor Vehicles and Repair & Installation. It was noted that Textile & Leather Products and Pharmaceutical Products showed a decline.

Finally the Well-Being Index update was presented. This showed that mental health in the sector has improved. On the other hand, the energy intensity of manufacturing has increased along with non-fatal injuries. Compared to the USA, the UK is performing better on fatal injuries and non-fatal injuries, while performing below the USA on average income.





A man in a dark blue suit and tie is standing at a podium, pointing his right hand towards a large presentation screen. The screen displays a diagram with a vertical stack of four orange cylinders labeled 1, 2, 3, and 4 from bottom to top. To the right of the cylinders is a blue trapezoidal shape. A speech bubble points from the blue shape towards the cylinders. The text 'University of' is visible in the speech bubble, followed by 'Strong for' and 'Weaker ab'. Below the blue shape, the text 'Research Groups' is visible. In the foreground, a computer monitor and a microphone are on the podium. The background is a light blue wall.

“In the future, the ability to design and make for a country’s own people will become very important. UK manufacturing has not had a good track record of being the best.”

Dr Hamid Mughal
Rolls-Royce

Cranfield
UNIVERSITY

Dr Hamid Mughal, Global Director of Manufacturing, Rolls-Royce and supervisory board member of the HVM Catapult, indicated that he would look at manufacturing challenges in three phases, looking to the past, today, and looking forward.

He suggested that manufacturing matters a lot; both from an economic capital perspective as well as from a social capital perspective. For the future, he suggested that with the resource constraints, environmental issues and a growing global population, manufacturing will become as strategically important as defence. The ability to design and make for a country's own people will become very important. UK manufacturing has not had a good track record of being the best. In terms of quality, delivery and operational performance, in the 1980s and 1990s the UK lagged best practice or world class performance. The best companies created the best possible standards, controlled those standards to become predictable and consistent, along with deploying the leadership and ambition to take the predictable aspect to develop a continuous improvement culture.

Leadership and employee engagement

That culture is developed from leadership, ambition and employee engagement. In that scenario leaders were coaches, not managers. The companies that succeeded in this metrics-based manufacturing industry in the 1980s and 1990s had two dominant aspects. The first was that they had employees who had values that focused on improving value to the customer, on removing waste and improving the product or service, and these values were

part of the company culture. The second was that they had behaviours that encouraged a never-ending desire to improve by working as a team and supported by leaders who were teachers and role models. The combination of these two created a continuous improvement culture and that is what separated the ordinary from the extraordinary. The companies that had developed this continuous improvement culture survived and thrived.



In today's environment, Dr Mughal said, market demands must be satisfied and businesses want to do that at the lowest possible cost. These seemingly contradictory objectives can be bridged through competence in manufacturing. Being competitive in manufacturing will be absolutely vital for companies – in the future, competitive advantage will increasingly come from manufacturing. Cost, flexibility and responsiveness to customer demands will determine how successful a business will be. To achieve that, it is necessary to do two things. Firstly, to implement the best practices available today, and drive those with a culture of continuous improvement. Secondly, to drive technological developments to make sure new solutions that develop new manufacturing capabilities are created. In the UK there has been a big historical constraint. Traditionally

universities are good at developing ideas in laboratories, but they cannot create great manufacturing processes, which requires an infrastructure. “In the UK there has been a tendency to look for low cost production solutions rather than turn early technology ideas into great manufacturing processes,” Mughal said. “That focus on low cost, sweating the assets. This includes offshoring to obtain low cost and was an easy option. That has been a mistake.” There has been a missing infrastructure in the UK for decades. The solution to this is the government/industry partnerships – the Catapults. This creates a national asset that benefits many companies. For success it is necessary to speed up this pipeline from innovation to profitability. As of today this pipeline is not fully defined and not fully understood.



For the future, the world is changing at a very fast pace. Mughal stated that for once in his career, he sees manufacturing at a threshold of significant change.

The next industrial revolution

Many technologies are maturing at the same time and within the next five to ten years there will be an opportunity to integrate these technologies to create competitive advantage.

Inter-connectivity on the shop floor with every machine linked. Assessment of the



“Being competitive in manufacturing will be absolutely vital for companies – in the future, competitive advantage will increasingly come from manufacturing.”

Dr Hamid Mughal
Rolls-Royce

machines carried out in real-time to maintain process capability. Sensors embedded in manufacturing processes allow adaptive control to be undertaken. There will be better visibility of processes and the entire supply chain. These are just some of the opportunities that will become available. This will allow companies to start making products 100% right-first-time. Inspection, rework, concession all become redundant. Value flexibility and customization become tomorrow’s norms. Manufacturing becomes data driven. This allows removal of employees’ interpretation. Today’s manufacturing is like buying a car and paying for a fitter to sit next to you in case the car breaks down. We have so many people wet nursing processes. In the future there is no wet nursing. The future is about total control of every process. For once, the future of manufacturing is playing to our strengths in the UK - knowledge and innovation.



Terry Scuoler – CEO of EEF

Mr Scuoler started by noting that although Anna Soubry MP stated that lessons must be learned from the steel crisis, she did not state what those lessons are and how they could be implemented. Posing the question why does UK manufacturing growth lag other countries, Scuoler noted that the metrics indicate that UK manufacturing is not in a good state. Manufacturing output fell by 0.3% in 2015 and EEF's forecast for 2016 is for modest growth of 0.6% - now that forecast, after a weak first quarter and now loss of confidence created by the Brexit referendum result, must be seen as under threat. Labour productivity in 2015 fell slightly by 2.1% and the PMI for April slipped further from 49.7 in March to 49.4 in April – the lowest PMI figure for manufacturing for six years. UK manufacturing is facing global headwinds. These include a depressed oil and gas sector, the slowing of key export markets such as China, Brazil and India, a flat Eurozone and a geopolitically incendiary Middle East. There is also the home grown 'headwind' of the UK public's decision on 23 June to leave the European Union.



However, exports of manufactured goods increased from £262bn in 2014 to £278bn in 2015, an increase of 6% and private sector industrial investment increased by

over 4% in 2015 and continues to grow this year. The United Kingdom is the seventh largest manufacturing nation in the world, according to EEF. It has some world leading companies. Rolls Royce, BAE Systems, GlaxoSmithKline, Jaguar Land Rover and the many supply chain companies which support them. Arguably more, larger manufacturing companies are required if the UK is to thrive but those that exist demonstrate world beating manufacturing excellence.

Scuoler noted that at a recent visit to Brussels he met with a senior European Commissioner and Vice President, who told him that “if seven years ago you had forecast what would happen to the British car industry I would have laughed you out of my office”. This indicates that large scale industrial recovery can be done. Investment in R&D, wider product and process innovation, market development and skills & training are keys to future success, Scuoler said. To also have the courage and foresight to continue to invest in these critical areas counter-cyclically to ensure increased market share and competitive edge when the inevitable upturn arrives is essential. Additionally, a competitive and secure supply of energy, an integrated national infrastructure plan which looks to procure from British companies whenever possible, a stable training and skills landscape that encourages young men and women to take STEM subjects at school, enter manufacturing apprenticeships and take STEM degrees at UK universities, are all needed.

He suggested that the UK needed good quality practitioners coming out of universities. Scuoler then turned to the issue of government support, noting that economic growth can only be driven by the private sector and companies



“As well as Brexit, manufacturing is facing global headwinds, including a depressed oil and gas sector, the slowing of key export markets such as China, Brazil and India, a flat Eurozone and a geopolitically incendiary Middle East.”

must ultimately be responsible for their own destinies. However government does have an important role to play. This is as a partner and to encourage a strategic approach to supporting and nurturing manufacturing by creating a positive environment for investment decisions. Scuoler suggested that this might be called an “industrial strategy”. He suggested that UK manufacturing is on the brink of a new industrial revolution, and the requirement on business leaders to invest in new, for example digital, technologies, is greater than at any time in history.

The contribution of manufacturing to the UK economy

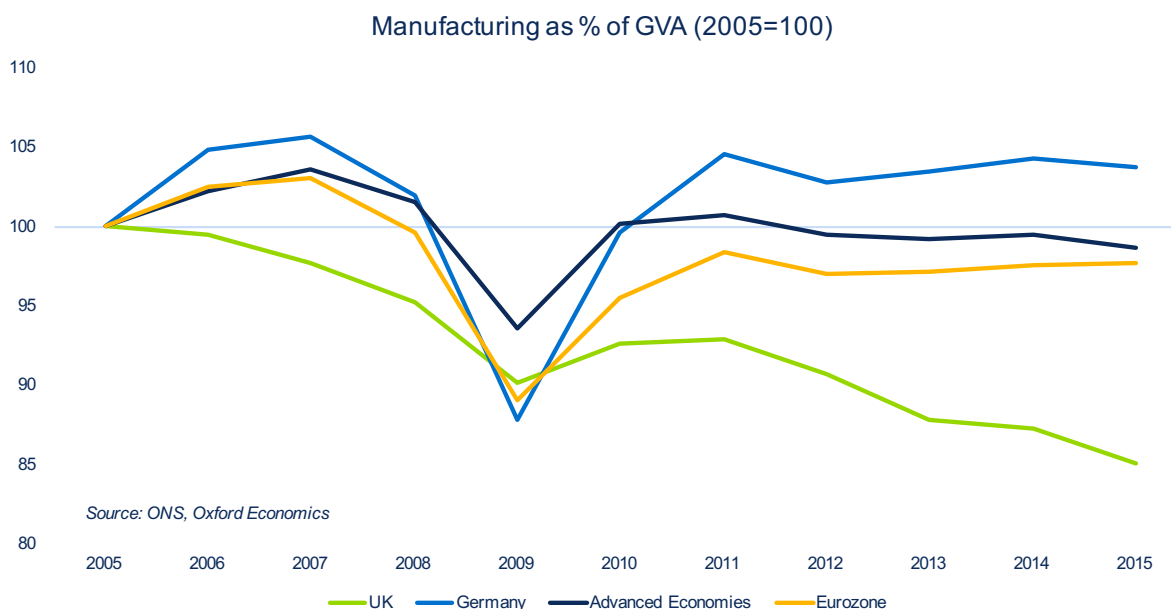
Anna Leach, Head of Economic Analysis at the CBI, commented on the contribution that manufacturing makes to the UK economy. Defining the size of the manufacturing sector matters because it helps in persuading the government to take an interest in manufacturing, she said. Leach said recent CBI research indicated that the manufacturing contribution to the economy was £310 billion in GVA, £230 billion in exports and double the BIS (Department for Business) estimate of employment created by manufacturing in the



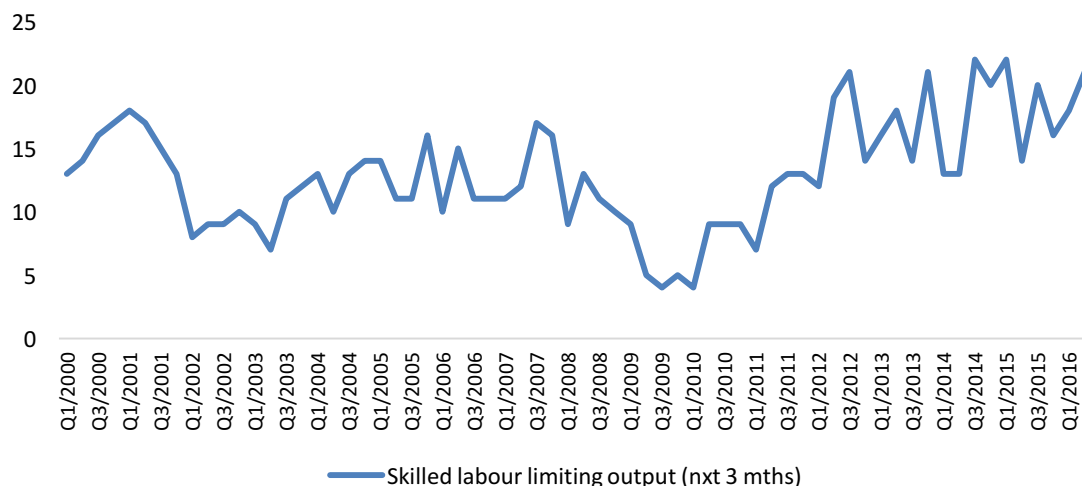
“Manufacturing GVA: It is ironic that the more a company expands in services as compared to traditional manufacturing activity, the more likely it is to be booted out of the manufacturing sector by the ONS”

Anna Leach
CBI

UK. In terms of manufacturing contribution, Leach noted that it was ironic that the more a company expanded in services as compared to traditional manufacturing activity, the more likely it is to be booted out of the manufacturing sector by the ONS (Office for National Statistics). The CBI looks at this from the perspective of how manufacturing drives demand from other sectors of the economy, Leach said. Using this view manufacturing contributes 19% to UK GDP. This makes it a very important area and worth paying more attention to than is often the case. Notwithstanding this, the manufacturing sector in the UK has been under considerable pressure for very many years. The manufacturing share of UK GVA has been falling steadily for some time.



Concerns that skill shortages will constrain output are above pre-crisis levels



It has fallen by a third over the last 20 years, with a sharper decline since 2011. Although there is a global trend for a decline in manufacturing in developed countries, the UK has fallen more sharply than other countries, particularly US and Germany. Indeed manufacturing in the US has increased its share of the economy.

CBI members have indicated that significant pressures on the sector are now:

Business rates, Energy costs, Supply chain constraints, Productivity, Innovation and Skills.

High energy costs are a major factor in the UK, putting UK manufacturing at a competitive disadvantage. Although the UK is globally competitive on gas prices, electricity costs are around 80% higher than the European average, and double the cost in the US. Among supply chain constraints, Leach stated that although UK automotive was a success story, the automotive supply chain was doing less well, noting that should the supply chain become eroded, this will put car assembly at risk in the UK – although many would add that the majority of component suppliers to car companies in the UK are foreign and have the scale to meet

delivery requirements. For skills, the concerns that skill shortages will constrain output are now above pre-financial crisis levels. CEOs at round table discussions have indicated that there is a problem attracting capable people into the industry.

Leach indicated that the UK was becoming overly specialised and had a comparative advantage in manufacturing in only three out of fifteen sub-sectors (pharmaceuticals, aerospace and chemical & related industries); the lowest of any G7 economy. France has that comparative advantage in five, the US in six, Canada in seven, Japan in eight and Germany in 10 sub-sectors. This puts the UK at more risk when faced with sudden changes in demand to those very specific sectors. In terms of growth,



the areas for opportunity are in China, India, UAE and Turkey. The key growth areas are those with a growing middle class.

Turning to productivity, there is great opportunity to improve competitive advantage. On a per hour basis, the UK is less productive than all G20 competitors except Italy. However, the UK is good at working long hours. Once the additional hours are factored in, the UK becomes more productive by around 5% than Germany and France. However, using this metric, the US increases its lead. On a per hour basis, the US is 45% more productive than the UK. On a per worker basis, the US is 61% more productive – working longer hours and being more productive per hour.

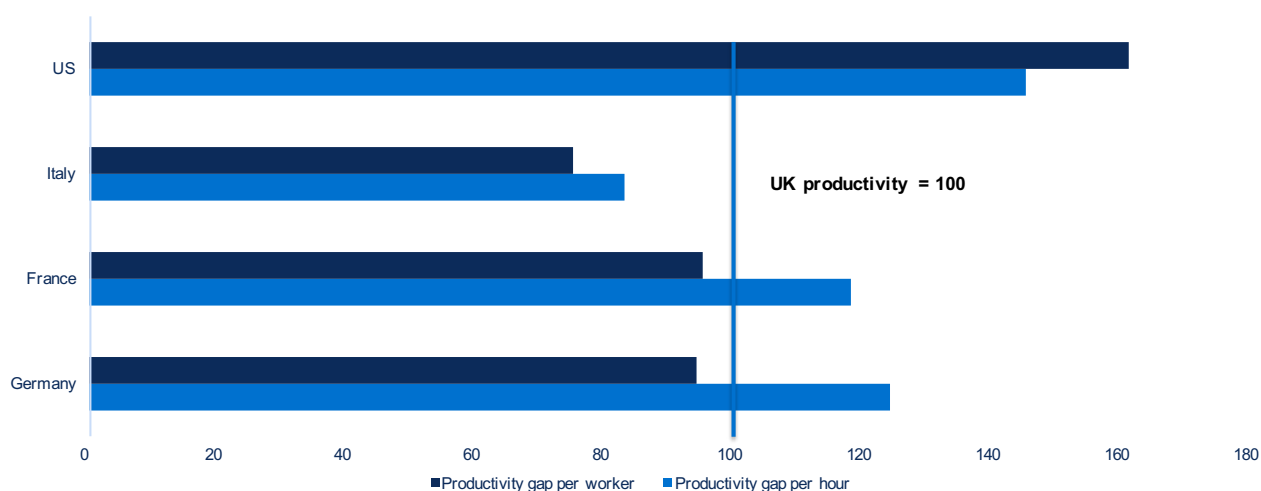
Recent research on productivity in Germany has focused on what is being done differently to the UK, Leach said. One of the factors that facilitates greater productivity is in company organization and management. One interesting case is that of China as a growing market. The UK has focused on off-shoring to China to reduce costs, whilst Germany has focused on improving management practices as a competitive tool that allows it to deliver

improved export performance to China.

“There is clearly opportunity for the UK to improve productivity by focusing on its management practices, using more innovative and decentralised processes to embed competitive advantage on a sustainable basis. Off-shoring to reduce cost will only provide a competitive advantage for a short period of time,” Leach said. The harnessing of digital technology will also be an opportunity to develop competitive advantage. Currently the UK is 14th in the world for the adoption of automation technology. In concluding, Leach suggested that policy support for a sector strategy, harnessing the devolution agenda, targeting R&D investment and recognising the cumulative burden of government policy would support UK manufacturing.

Leach concluded by saying: “There really is a disincentive to invest in manufacturing in the UK due to the absence of a formal industrial strategy that other nations have.”

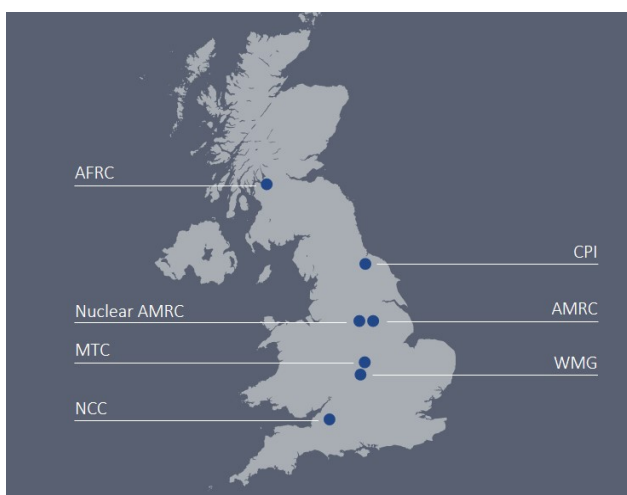
UK manufacturers work longer hours to close productivity gap



Dr Phill Cartwright, Chief Technology Officer, High Value Manufacturing Catapult opened his presentation with an overview of the Catapult centres; technology innovation centres designed to “bridge the valley of death”, between research and industrialization.

There are seven centres across the country: each has a slightly different focus, but all operate on the same basis – offering a combination of world-class equipment, access to academic research, expertise and an environment of collaboration.

The HVM Catapults’ key strength is the engagement with both industry and universities – involvement at both ends of the technology readiness spectrum.



Catapults will only work with the best universities and the best companies in industry, Cartwright said. Catapults focus on promoting the growth and success of advanced manufacturing by accelerating the journey of new concepts to commercial reality. The funding model for the HVM Catapult today is Public 19%, Commercial/private 48%, Competitive CR&D 33%.

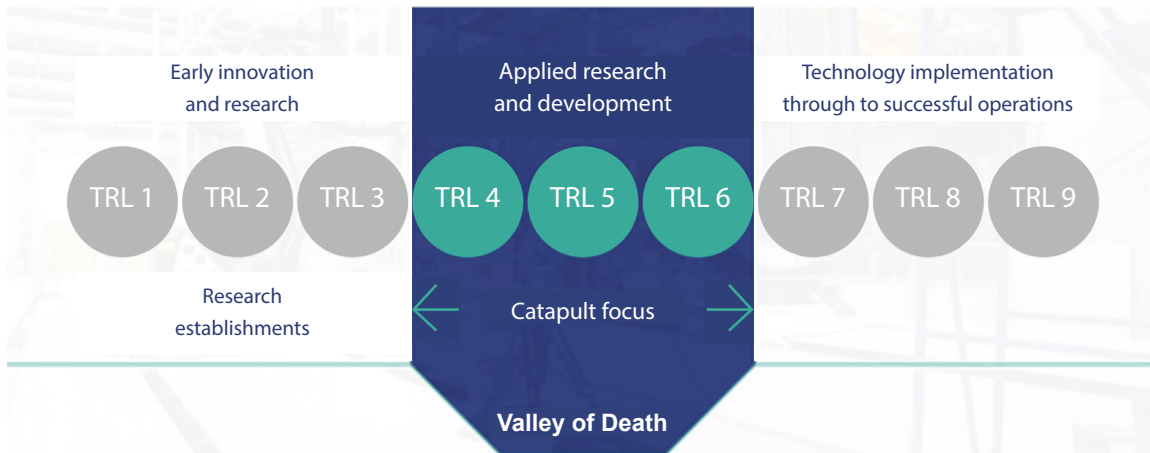


The problem that Catapults address

Cartwright said that companies that work on a prototype or small scale, and are contemplating scaling up to full industrial exploitation or contemplating integrating leading edge technologies into their business, face a high degree of risk at that stage. Faced with making very significant investments in capital infrastructure and in expertise but lacking confidence in success, it could be necessary to bet the business on the project. The consequences of failure are terminal, and this applies to both large and small companies.

However, companies engaging with Catapults are able to reduce the risk significantly because they will have access to the facilities and the expertise needed, without acquiring those facilities and resources. They can defer the investment decision until it has been demonstrated that the innovation can be scaled up and can be realised on a commercial scale. Although progressing well with technologies, Cartwright commented that he was surprised that on his recent return to the UK he had not seen a formal digital strategy from government. The Catapults work with companies of all sizes and although the high-profile customers include multinationals such as Rolls-Royce, BAE Systems, Jaguar Land Rover and Siemens, over 50% of Catapult customers are in fact SMEs.


Market failure: Bridging the Valley of Death



Cartwright described the Catapults as sector-agnostic, highlighting that a particular strength is these centres' ability to help technology innovation transfer from one sector to another. Three examples of ground breaking technology were offered. The first, SELSUS, a self-healing cell, combines a decision support system, a self-healing end-effector using memory that allows it to go back into position after the common end-effector crashes, and a self-calibration station for quality assurance. The project was designed and developed at the Manufacturing Technology Centre based on a real UK automotive use case.

Currently, investigation of unexpected automotive failures can take hours. With this system, the whole maintenance operation of a part can be reduced to under an hour in an environment where the operational minute is worth £10,000. This also allows prioritisation based on criticality and business metrics such as throughput.



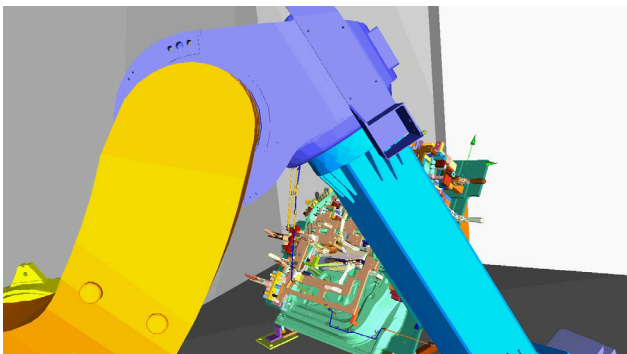
A large yellow industrial robotic arm is shown in a factory setting, working on a metal component. The arm is positioned in the foreground, with its joints and cables visible. In the background, other robotic arms and industrial infrastructure, including pipes and structural beams, are visible. A dark blue diagonal overlay covers the bottom left portion of the image, containing white text.

"The robot evaluates how the weld is being undertaken and this is compared to the original design parameters. The robot then uses algorithms that ensure that each cycle is improved upon the previous cycle."

Dr Phill Cartwright
HVM Catapult

The Digital Twin

The second is Remote Laser Welding Robot developed at Warwick Manufacturing Group. This uses simulation to programme the robot, and the robot then uses that simulation to carry out the welding. The robot evaluates how the weld is being undertaken and this is compared to the original design parameters. The robot then uses algorithms that ensure that each cycle is improved upon the previous cycle. This is an example of a “Digital Twin” where companies can save time and money in manufacturing by simulating the entire process digitally before trialling it physically.



The third is also a ground-breaking automotive example undertaken by Warwick Manufacturing Group with an automotive business. It is a small virtual factory or cell designed to produce battery cells. The cell is developed and tested to destruction in the virtual world. Algorithms built into the model allow the manufacturing process to be optimized. The manufacturing cell holds information about where the battery cell is located on the production line, as opposed to where it should be on the line. The algorithms allow the optimal pairing of battery cells to produce batteries that are most effective. The pilot line will become an open facility operating as part of the Energy Innovation Centre and the APC's Electrical Energy Storage Spoke. In closing, Cartwright noted that Catapults have worked with over 3,000 industry clients, 57 UK

universities and 24 international universities over the past 12 months.

Lessons in lean and employee engagement

John Reid - General Manager, Michelin Tyres (Dundee) and Director of Michelin Tyre plc stated that his presentation was about how the Michelin Dundee factory has reinvented itself over the past five years by focusing on people rather than technology.

Michelin is a big player in the tyre market with 15.5% market share. The organization has 69 manufacturing plants located in 18 countries. It produces almost 180 million tyres a year, for end users that range from bicycles to the Space Shuttle. Michelin employs 113,000 people with 6,000 employed in R&D. In the UK, there are three sites, Stoke-on-Trent, Ballymena and Dundee. The Dundee plant has existed for around 40 years and currently employs around 900 people. Turnover is around £300 million and products are car tyres. The production rate is around 1,000 tyres per hour, 24 hours per day, seven days a week. 95% of output is exported, with around 30% going outside Europe – including China, India and South America.



The workforce is unionized, predominantly with Unite. Flexibility is a key aspect for the Dundee workforce, with a flex of up to 24% up and 24% down. This facilitates meeting the variable demand to which the Dundee facility is subject. Reid then noted that lean is not enough to ensure survival.

When Dundee is one of 69 plants with standard operating practices, there needs to be a competitive advantage. People represent the route to competitive advantage. In 2005 the Dundee plant was threatened with closure. A group of three senior employees from Dundee, including Reid, were asked to present the plan for the plant's closure at Michelin's headquarters in France to. Instead they authored a presentation showing why the Dundee facility should not close. After what was described as "a few career defining exchanges" and much discussion, the group of three convinced senior management that the best decision was not to close the Dundee facility.

Several years later there was a requirement to downsize. The 2000s were a difficult time for Dundee, having survived several restructurings, morale was extremely low and at that time the



future of the plant again looked uncertain. There a feeling that it was only a matter of time before the factory would be closed. Performance was poor, with actual production missing plan by 1,000 tyres a day, scrap was over target by 50% and productivity was low. In 2010 Reid took over as plant manager and set about rebuilding performance through addressing people issues. Ignoring 42 of the 45 standard Michelin KPIs, Dundee focused only on three metrics for improvement: Safety, Production and Scrap. This was communicated to every employee in the factory. A dedicated progress team was established and people development became key aspects to enable this performance improvement. People-focused themes dominated: Motivation, Skills and People



Development, Relationships with Unions, Engagement, Flexibility, Diversity, Investment in Youth and Support for the Local Community were themes in the change programme.



People first

The objective was to engage people and give them a clear focus to make the change. Dundee did a huge 5S programme: improvement actions that ranged from repainting areas of the factory, tidying the site, to visual management, ensured involvement and engagement, and also demonstrating commitment to change. The plant introduced high external standards of presentation and ninety skips of trash and waste were removed.

An element of "fun" was introduced into the work environment. Initiatives such as a subsidised ice-cream van on site, a "hero of the day" award for particular examples of

good performance, support for employees to view World Cup games during working hours and contributions to charities for exceeding production targets all ensured that employees saw benefits from the new approaches. Seeing a "leadership vacuum" as key staff approached retirement, Dundee said 6% of total hours were focused on training, equating to 80,000 training hours per year. Reid noted that 50% of factory staff is ex shop-floor, and 25% of the senior team at Dundee is ex shop-floor employees. There is now a strong, constructive relationship with the union representatives. These representatives are high-calibre leaders with national roles outside the factory. Management and unions now meet every day and discuss problems early to get the best solution.

Michelin Dundee: Further highlights

Employee engagement has risen from 58% in 2013 to 82% in 2015. 95% of employees participate in the employee engagement survey. The survey led to improvement actions with 33 improvement action plans live as at May 2016. For gender diversity, recruitment is running at 50% female and one third of the senior team is female.

"SURVIVAL TO SUCCESS"

People Focus Themes:

- ✓ Motivation
- ✓ People and Skills Development
- ✓ Positive relationships with Unions
- ✓ Workforce Engagement
- ✓ Labour Flexibility
- ✓ Diversity/ Opportunities
- ✓ Investment in Youth
- ✓ Support for the Local Community

“The result of the change programme is that Dundee is now the number one performer across European plants for safety and production and number two for scrap.”



The apprenticeship scheme has continued throughout the restructurings and the recent change programme. Dundee currently has 64 apprentices, with half being trained for non-Michelin companies where these external apprentices are trained at no cost to the sponsoring company.

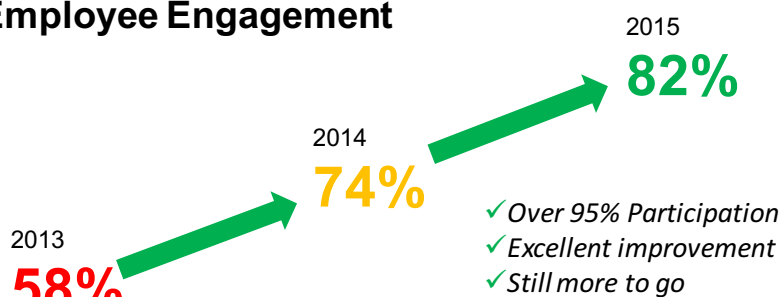
The result of the change programme is that Dundee is now the number one performer across European plants for safety and production and number two for scrap. The performance for the other 42 KPIs also improved as a result of the change programme. For supply chain metrics, Dundee was best in the group. Absence at Dundee is less than 1% for staff overall and less than 2% for shop-floor, making it again number one in the group

in this area. In closing, Reid stated that the performance of the Dundee site has been transformed. Improved employee engagement and a changed mind-set have delivered tangible performance improvement across a range of 45 KPIs and secured the future of the Dundee plant.

Lessons learned from the change programme are that it pays to be bold and aggressive when required; keep the plan simple and focused; and the most important aspect is to believe in the people. Lean although important cannot deliver the level of performance improvement that can be achieved when employees are engaged in conjunction with lean approaches.

WORKFORCE ENGAGEMENT

Employee Engagement



Growth and the small engineering company

Grant Jamieson, Managing Director, Winkworth Machinery is also chair of the Processing and Packaging Machinery Association (PPMA). He is a former RAE apprentice with a BSc in Engineering,. Winkworth is a UK industry leading designer and manufacturer of industrial mixing machinery. It makes and markets capital equipment with a price range of £10k-£500k. The business is focused on engineered-to-order products and has an annual turnover of around £6m, with 45-50 employees. The product is delivered on a lead-time of between eight to 40 weeks.

Z Blade Mixer



Double Cone Blender



"The annual turnover of SMEs is £1.8 trillion representing 47% of all private sector turnover in the UK"

Jamieson explained the contribution of small companies to the economy. That small businesses with up to 49 employees accounted for over 99% of all private sector businesses. The total employment in SMEs is 15.6 million, and 60% of all private sector employment in UK is provided by SME businesses. The annual turnover of SMEs is £1.8 trillion representing 47% of all private sector turnover in UK. There are 5.3 million small businesses in the UK.



Export to BRIC



- Has been available for countries where large growth was anticipated;
- BRIC Economies: - high cost of selling



Brazil



Russia



India



China

Mixing all ways

To facilitate accelerating manufacturing growth, the two biggest areas where SME businesses would benefit from support; in exporting and in skills. For exports, areas such as BRIC countries – Brazil, Russia, India and China – are particularly difficult for SME businesses with high cost of selling, import duties, agent fees, customs clearance and language difficulties all acting as inhibitors.

Jamieson said that markets in northern Europe are more suitable for UK companies, with familiarity with European pricing, engineering standards, compliance requirements and safety requirements. This offers a more level playing field. Here, agents are non-critical and English is widely spoken. The location is also commutable with a return trip possible within the same day by plane or train. In these

areas the UK can be competitive. Governmental support for SMEs exporting to northern Europe would act as an accelerator.

The second area of opportunity is in the “leadership vacuum”. As with many SME businesses, Winkworth will lose many of its experienced, well trained workforce and long serving employees over the next five to 10 years – maybe as many as one third of the workforce. Finding, attracting and retaining people with good manufacturing skill-sets is key to ensuring success for UK SME manufacturing businesses.



Accelerator – Government support in Exporting to Euro 😊

- Mature markets.

 Germany	 Holland	 Sweden
 France	 Denmark	 Belgium

Mixing all ways

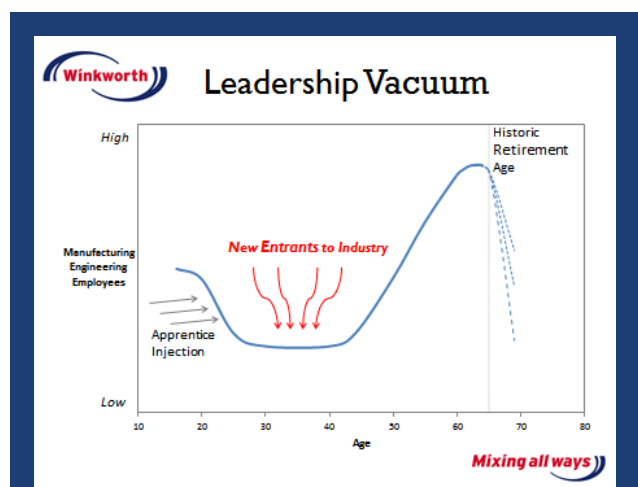
There are many efforts and initiatives to attract apprentices. There is a big effort to attract STEM students, but this is suggested by Jamieson as being age focused. The attention is on schools, universities and milk round recruitment. This is necessary to fill the skills pipeline. This will leave a gap in the mid-point between young employees and those approaching retirement. With the job losses in banking, retail, the NHS and Armed Forces, which may rise now with the Brexit decision, there is the potential of many people who could fill the manufacturing leadership vacuum. New entrants in the mid-age range, of 35 to 50 years, who can come into industry would provide a solution.



“A Masters in Manufacturing programme would allow development of up to a million people who could begin to fill the leadership vacuum.”

Grant Jamieson
Winkworth Machinery

To facilitate this, a Masters in Manufacturing, designed to convert people with banking, retail, defence and NHS experience to manufacturing leaders, is required. This would allow the development of a pool of up to a million people who could begin to fill the leadership vacuum. Government or company support, at a financial level, would facilitate manufacturing growth by developing a group of manufacturing leaders.



"As with many SME businesses, Winkworth will lose many of its experienced, trained workforce and long serving employees over the next five to 10 years – maybe as many as one third of the workforce"



The final speaker of the morning was Brian Holliday, Managing Director, Siemens Digital Factory who started by suggesting that while many manufacturers believe the previous government did a 'good job', many think the new Government needs to focus on several areas. They are:

- Training and education to address future skills requirements
- Encourage closer links between the industrial and academic worlds; and
- Concentrate on driving the uptake of new technologies to improve competitiveness.
- Accelerating growth could be achieved by using technology to improve productivity.

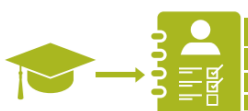
An overwhelming majority (86%) said Government needs a greater focus on STEM education at both primary and secondary school levels.



There is a desire for improved funding of and process for employing apprentices.



A greater industry-led development of education programmes to produce the skills required is also needed.



This sentiment only reinforces the widespread belief that by addressing the skills challenge, Britain will go a long way to securing a future competitive manufacturing base. It will be a future where industrial digital skills will be ready to embrace the opportunity presented by Industry 4.0, the fourth industrial revolution.



What's needed? Siemens leaders' poll

A poll of Siemens factory leaders indicates three areas that need to be addressed to facilitate growth. Skills is a critical issue for manufacturers, both in quality and type of skills. There is a requirement for both technicians as well as graduates. Bringing the world of work to those undertaking a graduate level of education would be beneficial, where this helps people who can contribute much more quickly to the working environment. For academic study, Holliday stressed the importance of a systems-based approach to undergraduate education, combining mechanical, electrical and software engineering, perhaps also design and politics, to provide a more rounded business education.

Overwhelmingly, manufacturers fed back that there should be **targeted investment at strategically important infrastructure improvement projects** including the road network.



They would also like to see **investment in the nation's energy infrastructure.**



78% wanted greater access to funding to invest in R&D and other innovative manufacturing techniques and processes.



Interestingly, more than half (57%) called for a commitment to an **Industry 4.0 strategy** to be embedded in any future Government, as is the case in Germany.



Nearly half (40%) asked for the **permanent establishment of R&D tax credits** and many called for a **reform to business rates** to encourage greater investment in plant and equipment.



To provide further support for businesses, there were **equal calls for a reduction in industrial energy bills**, the **expansion of enhanced capital allowances** for productivity and enhancing technologies such as automation.



On R&D investment the Government should focus on infrastructure investment, help manufacturers access funding to invest in R&D and establish tax credits, and focus on critical areas of business support. The UK's infrastructure is a critical component in supporting the manufacturing sector, so the Government's role in this area is a key aspect

to accelerating growth. More support in the area of implementation of innovation would benefit UK manufacturing. This is particularly relevant for Industry 4.0, the catchall name for new technologies to enable smarter, digital manufacturing. An industrial digital strategy would support this.

For technologies of the future, while there are already exciting technologies in use, the feedback indicated that manufacturers are planning further investment to help address obsolescence and improve productivity. Many companies recognize that the sector is on the cusp of significant change. The term and meaning of Industry 4.0 is now recognized as the “fourth industrial revolution”, however the sector is generally slow in making use of the technology.

Digital now impacts every stage of the product lifecycle. This is most visible in the automotive industry. Data used in the design of the product is taken into and used in the design of the factory. Gamification – playing with technology to simulate the best results – will increasingly become the norm. Siemens is about as productive as it can be with the use of lean and employee engagement, Holliday said, so

With new technologies at the heart of any gains in productivity and global competitiveness for manufactured goods, the significant majority (91%) of manufacturers are already deploying automation and control systems to help optimise operational efficiencies.



Industrial communications, controls and PCs are also widely utilised.



Looking at the short-to-medium term, the vast majority (83%) stated a desire to continue to invest in automation and control systems.

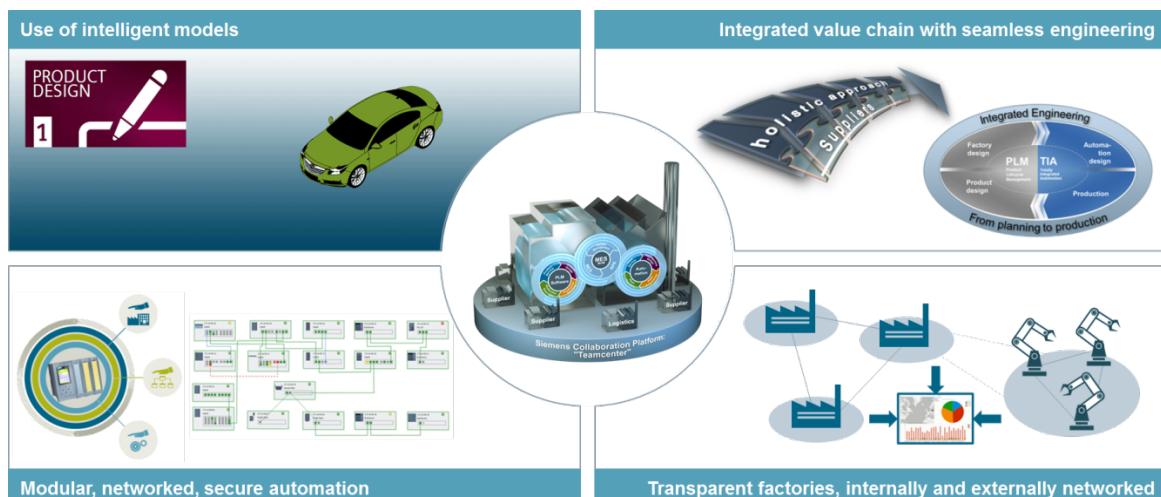


Plans to invest in other technology solutions such as sensor systems, integrated drive systems and operator control and monitoring systems carried a fairly equal standing, although these were not as high priorities.



the next stage has to be the use of technology. Industry 4.0 indicates what might be possible. The cornerstones of the digital enterprise are:

1. the use of intelligent models
2. an integrated supply chain with seamless engineering
3. modular, networked and secure automation and
4. transparent factories, internally and externally linked. Cyber security will become more important to protect the greater volumes of data generated and used.



Manufacturing debate afternoon session

Accelerating UK Manufacturing Growth

The 2016 Debate panel consisted of three speakers from the morning session,

- Brian Holliday
- Grant Jamieson
- Phil Cartwright

Along with two additional panel members:

- James Selka, CEO of The Manufacturing Technologies Association



- Professor Charalampos Makatsoris, Cranfield University



The Debate was presented by Ben Wright, Political Correspondent, BBC.



The Debate began with Wright commenting that in his coverage of political news, politicians tend to feed the narrative about manufacturing decline, but that he was looking forward to discussing the reality of UK manufacturing. The questions opened with a query from Bill Williams of the Centre for Manufacturing Excellence: why is the sector itself unable to motivate the government to move the sector from 10% GDP, why is the UK underperforming and what should be done about it? Andy Dobson furthered this by querying whether there is a lack of ambition in UK manufacturing, as suggested by the MTA's Selka during his introductory comments. Peter Alderslade noted that there were very few SME industrialists at the Manufacturing Debate. Selka stated that there should be more support, governmental and more widely, for manufacturing. "There does seem to be a culture in the UK of wanting to sell companies to get rich. It is

“A government that adopted a laissez-faire approach to manufacturing support would be uninfluenced by messages from industry concerning governmental support.”

Delegate



not appreciated how damaging that is to the workforce,” remarked Alderslade. There is little in the way of larger SME, or mid-sized, businesses – the UK lacks the same breadth of Germany’s Mittelstand, which have critical mass. This group of companies are famous for long-term thinking and independent investment decisions. They are a shining example of how the UK should grow its companies.

Disconnected government

Jamieson added that many members of the PPMA question whether it is worth raising the issue with government as they do not seem to listen. That was the case with the issue of a non-defined retirement age, where it has become very difficult to manage a business with the uncertainty about who will be part of the business as they approach a nominal retirement age.

Holliday commented that there was a “disconnectedness to the government’s approach to industry in this space”. The question of how government engages with industry has been very challenging over recent years. Although there has been some progress, this could be improved. One area that would benefit would be in government transmitting messages about the importance of manufacturing to the UK. The sector has an image problem that influences people who consider coming into manufacturing. Austerity has seen the demise of the Manufacturing Advisory Service, which was set up by government to engage with small to medium-sized companies in the manufacturing the sector. Holliday asked what will follow, adding that industry needs to improve the performance of the long tail of SME businesses. Delegate Peter Brown pointed out that many people in

Germany and China understand engineering. This is not widespread in the UK. These countries have strong regional support for manufacturing. They also have house or regional banks that support manufacturing organisations. Accessing finance is a key aspect to allow SME manufacturing to grow. It was noted that a government that adopted a laissez-faire approach to support would be uninfluenced by messages from industry concerning governmental support.

Phil Wareham noted reconnecting the community with engineering required early engagement – in schools with projects. There is a skills deficit in manufacturing. There is a question as to whether young people are interested in those skills that industry needs.



Makatsoris agreed that the difference between the UK and Germany is partly due to an understanding of engineering. Turning to finance, he also agreed that accessing finance is important for growth but that by looking inside the organisation and increasing productivity in the short-term, the requirement for finance may be reduced. An example of this is Michelin, described by John Reid, where significant improvements were achieved by making better use of what already exists. Makatsoris suggested that by looking at data in manufacturing, there was opportunity

to improve performance. Cartwright added that in BRIC countries there is a desire to move quickly. The UK is 14th in the world for technical adoption, and the biggest inhibitor to better adoption is the lack of skills to implement the technology. Cartwright suggested that a kite-mark accreditation for technology adoption would help. Peter Brown stated that the UK can never emulate Germany but can improve access to finance for SME companies. Holliday added that he felt bank support was improving. There is scope for improving engineers' understanding of finance, perhaps by including finance as part of engineering degree courses.

In terms of improving productivity performance Holliday stated that he felt the UK has gone as far as it can with lean, and that people engagement along with technology was now required to further improve performance. All three are required for the future.

Professor Raj Roy noted there is a change in culture required to encourage companies to collaborate. Makatsoris suggested that having appropriate metrics would support this. Jamieson disagreed here, that definitely more that can be done with lean for SMEs. The challenge is in making lean consultants affordable to the SME sector, he said. This problem is exacerbated by the lack of appropriate leadership in SME companies. Holliday added that although collaboration is important, there is much best practice knowledge available through trade associations and that more needs to be done in getting these people together. Government could help co-ordinate that more effectively.

Cartwright commented that collaboration occurs when people bump into each other – often accidentally. It is of huge value and



"The strength of many German companies is their ambition. UK examples do exist but they are less common. The UK has a copying mind-set. Having ambition would prevent this approach."

Peter Colman
Delegate

requires some investment and government intervention to facilitate this deliberately. Holliday commented that there is a different tempo from today's government. The industrial strategy previously proposed under the coalition government was seen as a good approach. Through austerity and a different approach from government this is not as visible, although "the conversations still take place". There is a need for a co-ordinating and leadership role from government. The current focus is productivity and exports, although this is largely being led by industry.

Raising the image

The image of the manufacturing sector was raised. Makatsoris stated that universities have a role to make engineering more attractive and that manufacturing can learn from the software industry. "People go into a career in banking and consulting and end up killing themselves out of boredom," he said. "In software there is the excitement of building something. It is exactly the same in manufacturing." Another perspective is that manufacturing is a place which is dirty. Perhaps it would be better to look at it as a data-driven environment where people go to solve problems.

Does manufacturing have a gender problem,

it was asked. Is it perceived as a sector where women would not want to work? Makatsoris suggested the problem was branding. Annette Doyle of Trumpf UK stated that she was a German/American who travelled the country for her employer. In the course of this she has met hundreds of people, but not a single woman. "It seems that 50% of the population is missing." Manufacturing management is mainly common sense, so management skills are transferable. With some training and mentoring a hospital manager could become a manufacturing manager. Therefore industry should look at ages beyond the apprenticeship ages, endorsing Grant Jamieson's points in his presentation.



Holliday agreed that there is a gender problem and a problem with encouraging young people into manufacturing. Looking beyond aerospace and automotive would probably help this, he

said. Holliday noted a recent manufacturing event where Pinewood Studios talked about how they manufacture sets for the James Bond movies - so sprinkling a little stardust around would probably help.

Selka added that not enough is done to support manufacturing. "Painting the lavatories pink to attract women will not work. There needs to be a better conduit to encourage more women into engineering." Jamieson suggested that SMEs could be flexible in employing people and if his company employed women he would be happy to be flexible to try to retain them. Holliday added that shift work is not always a big issue. The problem is that there are not enough applications from women. Cartwright suggested that if the challenge is there – or communicated better – women will apply. Peter Colman of Simon-Kucher & Partners noted that the strength of many German companies is in their ambition. UK examples do exist but they are less common. The UK has a copying mind-set. Having ambition would prevent this approach. The UK is good at innovation and design, along with a developed service sector. This should be promoted to young people who can be encouraged to enter manufacturing.

A regular NMD delegate, Claire Lauder from Interim Partners, said that the same issues recur each year; skill shortages, access to finance, high energy costs and short-term thinking from the government. The question of gauging this from year-to-year was posed: is there any measurement taking place each year? Holliday agreed that this would be a worthwhile area of research – perhaps a piece of work for Cranfield for 2017? However it was also necessary to look at the UK in comparison to other nations. In the last five years, Germany

was more interventionist, in rebuilding its industrial base. France has invested hundreds of millions of euros in re-industrialising its factories over the same period. Beneficial research would be how the UK has responded to the challenges laid out five years ago in comparison to other nations. The UK will fall further behind unless it does more.

Will Stirling asked if boosting the image of the factor could be done through the disruptive technologies – "the sexy end of manufacturing", such as 3D printing and rapid response to customer demand. This would be more attractive to young people eager to work in digital industries and make new products, boost manufacturing and increase its contribution to GDP. Cartwright believed that the UK is well-positioned to take advantage of this. Many small businesses work with these emerging technologies. Government needs to incentivise long-term demonstrators in these areas.





The next industrial revolution

The issue of Industry 4.0 was raised with the panel being asked if this was a challenge from a hardware perspective or a software perspective. Makatsoris responded by suggesting that it was a cultural challenge – embrace new technology and use it. “There is a problem that people can become data entry clerks rather than using software that analyses data to help make decisions. With more automation there is a cost, but there must be a balance to make people adopt this technology,” he said. Cartwright said flipping the business model comes first, while the issue of hardware and software comes afterwards. When this is achieved, the use

of technology to support it will require both hardware and software. The real issue is how is to flip the business model. That flip worked well for Rolls-Royce in moving to a servitized approach, due to the culture of coaching and mentoring people. Mentoring is well established in the business culture in countries such as China and India. It is not normal in the UK and the reasons are unknown. Selka suggested that there was a need to mentor business leaders about the potential of digitization as a solution to the productivity problem.





Conclusions

How to accelerate manufacturing growth

In concluding, the panel members were asked what they would like to see to accelerate UK manufacturing growth.

James Selka

- A higher ratio of women in engineering and studying STEM subjects
- An increased level of investment in new technologies

Brian Holliday

- Investment needs to be increased.
- Apprenticeships should be expanded and made to work well with the Apprenticeship Levy.

Charalampos Makatsoris

- Development of appropriate metrics
- More on management of data to maximize benefits of manufacturing
- Address the skills gap
- Paying attention to the employees of an organization to improve employee engagement

Phill Cartwright

- Increased investment
- Consistent investment
- Long-term investment

Grant Jamieson

- Creating a manufacturing masters course to migrate people coming out of other industries into manufacturing
- Attract European engineers to work in the UK



Eight key factors required for accelerating UK manufacturing growth

1. Better manufacturing leadership
2. Improved employee engagement
3. Increased investment in technology (Industry 4.0)
4. Greater focus on improving productivity
5. More ambition from SME manufacturing businesses
6. More women in manufacturing
7. Government sponsored UK manufacturing strategy which is sector specific
8. Government support in promoting manufacturing



**The 2017 National
Manufacturing Debate
will be held on May 24**

www.national-manufacturing-debate.org.uk

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Events

Manufacturing 2075
7 December 2016
www.manufacturing-2075.org

National Apprenticeship Competition
23 May 2017
www.national-apprenticeship-competition.org.uk