



National Manufacturing Debate

Supply chains in 21st-century manufacturing: developing sustainable supply chains for UK manufacturing growth

10th National Manufacturing Debate

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Overview

This year's National Manufacturing Debate, now in its tenth year, focused on supply chains in 21st century manufacturing. Following on from last year's debate around whether the Government's Industrial Strategy will help rebuild manufacturing, the event brought together professionals and academics from a range of sectors to debate current challenges in the industry.

Professor Helen Atkinson, Pro-Vice Chancellor, School of Aerospace, Transport and Manufacturing, in welcoming a packed room to the event, immediately highlighted the timeliness of this year's topic in light of the juxtaposition of current events - with Brexit driving into the open the importance of supply chains.

It was a day of intense debate, which succeeded in drawing out key themes that will undoubtedly help develop sustainable supply chains for the future - from the skills gap - and not simply within the manufacturing industry - to the value of innovation and digital tools to connect people and make supply chains work harder, to leadership - or lack thereof - as well as softer areas, including the need to address business culture and collaboration. All this, against a volatile global social, economic and political climate that is not set to go away any time soon.

It was a day of speeches and debates that made plainly clear that it was our absolute collective responsibility to play a role in the success of future supply chain ecosystems both in the UK and across the globe.

NMD topics since 2010									
2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Manufacturing for recovery	Investment, incentives and innovation	Enhancing the supply chain for growth	National strategy for UK manufacturing	Manufacturing productivity in the UK	UK reshoring capability	Accelerating UK growth	Leadership and investment for manufacturing skills	Will the published industrial strategy help rebuild manufacturing?	Supply chains in 21 st -century manufacturing: developing sustainable supply chains for UK manufacturing growth

@Chris_White_67

Launching #mfgdebate @RMW136 with @john_pats @MarkRJolly - supply chains in 21st Century Manufacturing - 'moving the debate beyond these walls' @CranfieldUni @beisgovuk @Catapult_UK

Introduction to the National Manufacturing Debate

Professor Mark Jolly kicked off the day, but couldn't fail to mention how apposite British Steel's announcement of insolvency was to today's debate - with 5,000 jobs at risk and endangering 20,000 in the supply chain, the day's challenge was made all the more real - as if it wasn't already.

Mark explained that for thousands of years, manufacturing has taken the same form - taking elements out of the ground and transforming them. While this has not changed, modern manufacturing is now so much more than the materials - as much about environmental, social and economic factors. And as we enter the fourth industrial revolution, the supply chain is not a linear chain at all - its a network, a web that brings everything together effectively and efficiently.



Professor Mark Jolly,
Acting Director of Manufacturing,
Cranfield University

The debate's chair, Rosa Wilkinson began by posing fundamental questions everyone in the room wanted answers to:

In the present political climate, are we ready for a turbulent future? How do we truly understand the challenge of creating well managed supply chains? And who does this matter to - to the 2.7m people working in manufacturing in the UK, to every person in business, with their hands on the UK economic tiller; but as much, she explained, it matters to every man, woman and child across the UK, as we continue to address the wider social, environmental and economic challenges around carbon emissions, development and construction. While we in the room are providing the starting point for supply chains to work harder, she urged everyone to take the debate outside of this lecture theatre - and to bring the world in.



Rosa Wilkinson,
Director of Communications
High Value Manufacturing Catapult
(HVM)

Keynote 1

Dick started the day on a positive note, championing the UK's abilities in technological research. But what we aren't so good at is the commercial reality of embedding the value add of this research and development into the UK economy.

HVM is an organisation wholly geared towards stimulating innovation in UK manufacturing. In 2018/19 HVM has supported more than 4,650 private sector clients, 53% of which are small businesses. With 18 locations across the UK, HVM has delivered £300m of direct R&D activity in the last year (funded by government, industry and from winning collaborative projects) - and with a team of 2,900, they boast the greatest concentration of R&D activity in advanced manufacturing in the UK.

But, Dick explained, embedding UK value is so much more than just working on the technology - we need to bring in skills and a well managed supply chain. "Its all very well working on a collaborative R&D project with big companies - we get great success, we develop the technology. But if the supply chain isn't brought along on this journey, it isn't going to happen - or worse still for the UK, it is going to happen but not on our shores."

Dick concluded by sharing two great examples where HVM is helping support UK supply chains initiatives:



Dick Elsy CBE,
CEO, High Value Manufacturing
Catapult

Fit 4 Nuclear Programme

A practical supply chain engagement programme driven by the nuclear sector, Fit For Nuclear (F4N) is a unique service to help UK manufacturing companies get ready to bid for work in the nuclear supply chain - including decommissioning programmes, waste disposal programme at Sellafield and the new build at Hinckley Point. F4N enables companies to measure their operations against the standards required to supply the nuclear industry - and take steps to close any gaps. The impact has been huge, with around 1,000 companies taking the initial assessments and 135 companies already granted F4N status. The combined CNSiG and F4N programmes have already delivered over £550m of nuclear contract wins, supporting over £50m of private investment and creating 6,500 jobs.

Automotive batteries: the Faraday battery challenge

The Faraday Battery challenge is driving electric revolution and transforming construction - a £246m government programme to drive battery capability for the automotive industry in the UK. Led by HVM together with Warwick Manufacturing Group (WMG), the initiative has mapped the UK supply chain against what is needed in the UK. The best illustration of its success is a supply chain programme by the Advanced Propulsion Centre (APC) at WMG and in concert with Innovate UK to get chemical industries engaged. HVM invited everyone identified in the mapping exercise to meet the major car manufacturers, demonstrating the demand signals so they had a clear picture of the size of the opportunity and how to grasp it. But it went further than that - at the event the Government's Chief Mining Engineer advocated that with lithium and cobalt deposits and geothermal energy found in Cornwall, there was a real possibility that the UK could become entirely vertically integrated in lithium iron batteries - from digging out of ground to driving around in cars fuelled by lithium iron battery technology.

Keynote 2

Andy opened by explaining that BAE Systems experience many of the same challenges as faced by others in the sector. As the third largest global defence supplier, BAE Systems has a massive reliance on the supply chain on a daily basis, spending £4 billion per year.

The future combat air strategy, launched at last year's Farnborough Air Show, identified key manufacturing challenges for the BAE Systems Air division: the need to double productivity through a smart connected factory, to reduce lead time and waste through a connected supply chain and to double labour productivity through integrated intelligent automation. This puts significant pressure on the supply chain - "and its currently nowhere near what is needed to meet the reduced lead times, reduced cost and more efficient manufacturing process."

To meet these challenges, BAE Systems is looking at disruptive technologies, particularly around additive manufacturing, seeking to reduce timescales down from 100 weeks to 100 days - achieving this through human-machine collaboration, reconfigurable and agile assembly, affordable assembly processes, data driven and intelligent logistics. This is the factory of the future.

Andy contemplated what all this means for the supply chain - like other industries, we need real time visibility of the product status in the factory, track and trace and validation of products to ensure authenticity and origin of parts, as well as predictive analysis and compliance with new and existing regulations.

Andy referenced initiatives that BAE is involved in, including Made Smarter, HVM, AMRC North West and Lancaster University's Productivity through People - all focused around knowledge transfer, leadership skills and grant funding support across the industry. "We all need to work together in a more smarter, collaborative and connected way - we want to support the supply chain and help them through the challenges we see."

Following Andy's talk, Rosa Wilkinson asked the question: If you had to give the companies within your supply chain marks out of 10 for digital readiness what would it be?" Andy's answer. "It's low and is a real challenge."



Andy Schofield,
Manufacturing and Materials
Strategy and Technology Director,
BAE Systems

@Shahs_UK

The Manufacturing Challenges as per #baesystems Andy Schofield #UKmfg "needs to create value through disruptive business models" #MFGDebate

Keynote 3

An engineer who by his own admission fell into academia, Richard is a prolific voice in the industry, not least as Chairman of the Chartered Institute of Logistics and Transport UK. Richard's focus was on how we ensure resilience in the interconnected supply chain in this increasingly digital world.

He explained the concept of Supply Chain 4.0 and that by taking elements of this and combining - taking additive manufacturing and putting it into a warehouse infrastructure, or using augmented reality supplemented by autonomous systems - all the planets are now aligning to create real innovation. But, he warned, with it comes volatility. The world is not the same as in the 70's and 80's - there's far more uncertainty and the processes and theories of 30 years ago simply no longer work.

So what now forms the foundation of an effective supply chain strategy? If the corporate strategy is global domination and the competitive strategy looks at how to create value for a customer, it is the supply chain strategy that answers how we deliver that value - through process, infrastructure and information system design - but crucially Richard identified, through organisation/society design and the alignment of core values within companies working together through the supply chain.

A case study on the real impact of additive manufacturing, Richard explained how global sports retailer, Nike, made plans to cut lead times from 60 days to just 10. By moving from their current model of 1m workers at 566 factories, 75 distribution centres and 30,000 retailers in 190 countries, their future looks rather different: 1,200 new automated machines; Nearshoring - reducing shipping expenses, import duties and over-production risks; 30% fewer steps crushing the lead time - but hidden in there was 50% less labour. The creation of this new sustainable supply chain would put 500,000 people out of work and could lead to huge social, political and economic unrest. Richard questioned could this in itself the disrupt supply chains in the future?

There are also new business models emerging based on what people want - a move towards servitisation - from supplying products to delivering solutions. Successful examples include Rolls Royce's Total Care, Xerox's Document Management and Nespresso's bluetooth connected subscription-based app. No longer are you purchasing a machine, you're buying the service.



Professor Richard Wilding OBE,
Professor of Supply Chain
Strategy, Cranfield University

So how do we make this volatile, complex world more sustainable?

The answer - just as every business has a management strategy. We need an effective supply chain strategy. And to do this Richard introduced the supply chain resilience temple. At the base is product design - a real risk area if reliant on specific materials. Above that, collaboration is critical - we need to manage relationships and cannot treat people as commodities. Then the four pillars - agility, collaboration, embedding a risk management culture and finally supply chain design - consider the locations and network, and the equipment you use. This is held together at the top by transparency - delivered through connected information systems and good communication - and by continuous monitoring and intelligence, helping to secure and maintain the resources you need to keep your supply chain operational.

Richard spoke of the increase in supply chain terrorism. The worrying fact that on average supply chain terrorism occurs 3.7 times a week led Richard to champion the need for a frictionless border. If more operators reduced their customs risk by securing Authorised Economic Operator (AEO) status, this would create a green light through customs, serving to increase security and safety through the supply chain. A network of AEO companies would present collectively lower risks, helping increase frictionless movement across borders.

Richard concluded by championing the use of Cyber Essentials <https://www.cyberessentials.org>. "Most cyber attacks on supply chains occur through supply chain partners." Some painfully expensive examples included Target (a hack from a heating and ventilation supplier) and a similar attack on Google Australia, so Richard's message was don't delay - get protected. Defend your interconnected supply chain, it's your temple of supply chain resilience. And his final thought and top tip for the day! "Passwords are like underwear: don't let people see it, change it often, and you should not share it with strangers"

Questions

Paul, Data Analysis Bureau

Q - Do you see geopolitical factors such as the US/ Chinese trade war playing a more significant role in supply chain volatility and how will it manifest itself?

Richard - Yes it will. Brexit is actually just a minor local disruption in terms of global supply chains. It goes on all the time in other countries and the supply chain will always find the easiest route through. It will create more volatility meaning we have to do things differently and plan accordingly!

Sadiq, MSC student, Cranfield University

Q - If there will be 50% less labour in supply chain, what type of jobs will be missing in the future?

Richard - It's already happening. Nike employed 122,000 people in Asia and have reduced this down to 1,000. This in itself can create more of an environment for supply chain terrorism. And it means new skills are now required. Technical skillsets are now coming to the fore - IT, automation, analytical skills. The role of lorry drivers will undoubtedly change in future. Yes, someone will drive but more likely from a control room rather than the cab.

Keynote 4

With his opening remark, 'We are part of the tide that raises all boats,' John's presentation was all about collaboration. Have you ever seen a supply chain John asked? A few murmurings but most admitted no.

Most are abstract concepts you can't visualise. From chain to web, nodes and networks, they don't operate in a vacuum - they operate in ecosystems that bring together financing, technology, integration, sustainability and policy. Here at Cranfield, he explained, our research looks at all the factors, with supply chain finance, new technology and collaboration the top three. Positive collaboration is based on game theory - ultimately win-win has a bigger value than win-lose or lose-lose. The message, don't play games with your suppliers. That's win-lose and will mean less value for you and your supply chain.

In the ecosystem of modern UK manufacturing, there are many players, from OEMs, LEPs to Government, Universities and SMEs. And these - especially in turbulent times, need to be coordinated, benefiting from conducive orchestration of all elements. The people running factories have an impact on many lives, on their community - John's message, support each other in the supply chain and invest in your people.

John ended his talk with a phrase born in Cranfield, arguably the home of supply chains, "Supply chains compete, not companies," concluding, "We can create value, no matter what the turbulence. If we pull together in the ecosystem there will be good days for manufacturing ahead."



John Patsavellas
Senior Lecturer in Manufacturing Management, Cranfield University

@HVMConference

"Don't play games with your suppliers. Don't play win-lose with them. We care about this."
Prof John Patsavellas at #nmd19
#Cranfield today
#supplychain
#MFGDebate

Debate - part one

Are UK manufacturing supply chains ready and flexible enough to ensure growth in turbulent times?

Panel members:

- **Dick Elsy** CBE, CEO, High Value Manufacturing Catapult
- **Andy Schofield**, Manufacturing and Materials Strategy and Technology Director, BAE Systems
- **Professor Richard Wilding** OBE, Professor of Supply Chain Strategy, Cranfield University
- **Lord Alec Broers**, Non-executive Director, FlexEnable
- **Mike Wilson**, Managing Director, Kuka UK and Ireland
- **Halil Bedevi**, UK Head of Aerospace, Defence and Advanced Manufacturing, Santander Corporate and Commercial

Rosa Wilkinson kicked off reiterating the focus of the morning's keynote speakers - the need to embrace new technology and for greater resilience in the supply chain.

She asked: With too few companies gripping the challenge, how can we make it easier to help prepare them to be part of an effective supply chain?

Dick Elsy - We need to make companies aware of the opportunities, get the supply chains connected to opportunities and give everyone the necessary visibility and foresight. On their own, people feel left behind and uniformed. Company owners have limited bandwidth or capacity to understand the opportunities. The catapults, can help by signposting where these opportunities are and plug them in. The future is really bright. The UK can be deeply competitive if informed.

In his keynote, **Andy Schofield** cited some great case studies in the North West of England but acknowledged it was all well and good to show examples, but he is starkly aware of the challenges faced by SMEs not being able to do it. He championed the reach of HVM and using their centres to support, generate and build better supply chains.

Halil Bedevi is on a different mission and wants to bring banks and industry together. He focused on the importance of people - key to making decisions, to making companies good or otherwise. There is a skills shortage for operators, but also engineers and management. We need to go up a step to find the right people - there is a gap in engineering as everyone flocks towards IT or electronics. And he wanted to see more medium sized companies - while small companies are vital and large multinationals know what they are doing, we need more medium sized company for the smaller ones to feed into. We also need to internationalise - encouraging companies to be competitive at an international level. We're only ready if we have companies who are agile enough to cope with change, everything from Brexit to trade wars. Finance clearly comes into it. As a bank we want to help companies grow and prosper in any way we can.

Rosa asked **Mike** if when selling complex systems, is there a lack availability of people to understand how to use the products and services you supply. Yet Mike said no, the technology is relatively easy to use and maintain. At Kuka they train customers personally. The bit that is actually missing is people to walk the factory floor and identify automation opportunities. Many think that the most difficult jobs to automate will give the best payback, but Mike argues it's better to find the simplest job to automate and work from there.

Richard raised the issue of leadership in the boardroom - and a lack of skills with which to truly lead. He explained that the Apprenticeship Levy on the Level 7 leadership standard is now actually allowing us to develop leaders. There was a gap in awareness - a lost generation - but we now need to 'Professionalise the profession.'

Lord Alec Broers - The countries leading are where manufacturing has the most prestige - we are mixed bunch here in the UK, with the brightest go into pure science...but how to do you get the bright people into manufacturing? As John said earlier, Cranfield is a small place but is the centre of supply chains. Alec said simply, we need a larger community of bright people to come into manufacturing.

Questions from the floor

Paul Calver: There is a lot of investment from government to help develop technology in the supply chain. Do we have the right financial structure in place - in terms of equity investment, working capital - to support the development of supply chains in UK?

Dick Emery - Most government interventions in financing are to do with market failure. In Germany the regional banks take a long term view, but here in the UK we are more hard nosed and capitalistic. We are working with the main banks in UK who all want to lend to the manufacturing industry. We're chasing the same people and by helping de-risk the technology it will de-risk the investment. It's a symbiotic relationship.

Mike Wilson cited the 'Making Good' study looking at the culture of manufacturing. It found that here in the UK, we are eminently proud of keeping old machines running, yet in Germany, they are proud they bought new ones! We need to think about investing in capital equipment beyond a year and think longer term to justify the investment. Banks are looking for the people to lend to - and are willing to lend - but you need to have the right business case.

Rosa Wilkison suggested that one of the principal challenges is the ability of companies to manage their finances effectively - compounded by the uneasy journey of bringing venture capitalists and companies together.

Helil admitted that the banking system is not ideal for some companies. We are doing our best to support commercial organisations - but there's only a finite amount of money and its difficult to risk assess companies. That's were people like Helil can really help bridge the gap - not being a banker, its for him to find what good looks like. But he admits it's not easy. We need companies to innovate and start ups to come through - but statistics show that many won't succeed. It becomes inefficient to support all the losers to get a couple of good ones. Banks aren't looking not to help, on the contrary - they are trying to recognise the right companies to support.

Bill Williams CEME: How important is geography to innovation and how attuned is the policy of co-location to developing sustainable supply chains?

Andy Schofield - Location is vital and that's why the regional catapult centres are so important. For air, submarine, automotive and nuclear businesses, co-location has helped address challenges in the supply chain. An integrated approach having the supply chain and industry around a product is vital.

Dick Emery - There's a recognition that we need help locally to satisfy demand and respond to demand signals. HVM is about to 'cut turf' on a brand new National Manufacturing Institute for Scotland in Strathclyde - we are creating an open access broad spectrum capability north of border because the demand is there.



Richard Wilding - Location is important however we should remember we do have whole raft of technology enabling face to face discussions without meeting up. Our Learning Suite here at Cranfield brings up to 80 people from around world together in a virtual classroom. We need the physical but virtually the technology is ready and there's a whole new generation who quite frankly prefer that type of interaction.

Rosa Wilkinson picked up on a question from Ken Lewis in the audience that people need insights that are not necessarily taught in education - including leadership and finance. How do we give people access to this?

Richard Wilding - Leadership is critical. Modern leadership approach is collaborative as well as the more traditional methods. Having to switch between different modes depending on what they are dealing with can be a challenge. In terms of finance, the cost to serve is key. Those who have the biggest impact are logistics people who have learned finance. We shouldn't get into paralysis of analysis but the cost to serve pathway is a core skill we are trying to embed here at Cranfield.

Lord Alec Broers - Leadership depends on real experience and being in the situation themselves. We don't always allow people to have right careers. The best Cambridge graduates went straight into City to advise on investment - they had high IQs but no experience. Let people go out and build careers - be an engineer before going into management. Banks should hire more people who have been in industry for 20 years who understand what it's like to run a factory.

@Shahs_UK

"How important is geography to innovation" - brilliant viewpoint at the debate - its all about Location Location. Location #MFGDebate #SupplyChain #Manufacturing #SCM



Keynote 5

With talk of lemmings and supply chain porn, Janet's keynote was perfect for the post-lunch spot.

In looking at supply chain digital readiness across Europe, Janet asked whether you were a lemming, following the market to failure, or a leader, creating competitive advantage for your business from good digital supply chain management. From sticking to the plan, knowing your goals to understanding your supply chain personality, Janet identified nine strategies to avoid being a supply chain lemming. And this included not getting sucked into the hype of 'SC porn' (media, publicity and advertising) suggesting many companies now have block chain projects simply because it's trendy or cool - and not because it's necessary.

Supply chain management is about balancing demand and supply. In her role at Dyson, at the time an SME going through an extreme period of growth, Janet experienced that fine balance, managing risk to maximise profit and minimise losses. To be a leader, you need to think how you drive change, improvement and productivity. To achieve this you must be willing to adapt, be diverse in your thinking, demonstrate leadership characteristics and be accountable for the vision and execution. All great leadership characteristics regardless of whether you're in the supply chain or not.

Looking back at supply chains since the principles were established back in 1992 by Martin Christopher, Janet then asked the audience what is different about the digital supply chain - faster response perhaps? "It's the same." She explained, "Digital technologies are enablers to overcome some of the issues of supply chain theory which has been around for three or four decades, and finally make them work in practice."

She continued, "This is probably a once in a lifetime opportunity to use these technologies to drive step change in the productivity of our end to end supply chain - and crucially to maximise the role the UK can play as part of that network of global supply chains."

At WMG, Janet has conducted research looking at 11 supply chain processes, identifying four levels of supply chain digital readiness - using these parameters they considered the readiness of 178 companies across Europe, finding that only 13% are at level 3 readiness and maturity. And even with great ambitions, on average companies will only move half a band in five years. The jump from level 2 (predictive) to 3 (prescriptive) is considerable.



Professor Janet Godsell,
Professor of Operations and
Supply Chain Strategy, WMG
University of Warwick



She identified four strategies to help support the digitisation of supply chains, arguing organisations can't simply pick one, that they need to do all of these to impact different parts of the business.

Core process optimisation - Janet cited the supply chains operations reference model developed around five processes: build data infrastructure, improve data capture, improve data analytics, sustaining legacy business all to create a bedrock of operational excellence - doing the right things and doing them well.

Business process optimisation - hardly any organisations are doing this as it requires fundamental changes to your business structure, yet in aligning the commercial, supply chain and product strategy, this orientation with support end to end optimisation and supply chain alignment.

De-risk supply chain digital technology pilots - do as many digital technology pilots as you can. You want to fail or succeed fast. But you should do them in safe areas - don't fall into the 'wally box' of Ansoffs Matrix. New products in the same market work, as does the same product in a different market. Yet the 'wally box' - new products in new markets is always highly risky and likely to fail. The same applies to new technology.

New business models are required to thrive in the changing business landscape and consumers sit at the heart of this. For Generation Z, consumption driven growth is failing as the impact on society and the environment is too great. How can we make money

by making and selling less. We should be thinking about new models of servitisation to support a more circular, sharing economy. And this means we are seeing a different design in our supply chain, with the balance between global, local and regional becoming more dynamic.

The key is not to be a lemming: if you think in your gut something feels wrong on your digital journey, STOP. Don't follow the herd over the cliff. Think about how to apply these four new strategies to become a supply chain digital leader.

@Cranfield_MFG

#MFGDebate @JanGodsell
"Don't get sucked into the hype"
of #supplychain complexity,
things are simpler: Try and
balance supply and demand
and maximise profit and
minimise cost.

@Shahs_UK

"Customers at the heart of new
business models" by @JanGodsell
#MFGDebate #supplychains #UKmfg
@CranfieldUni

Keynote 6

Juergen started on a positive note - with 15 factories in UK and despite the difficult political climate, Siemens believes in the UK. We have a great skills base and the R&D ecosystem is great.

Despite what others say, we have some amazing manufacturing companies making and innovating here in the UK. However he agreed with earlier speakers that the balance of tier 1 to SME is not quite right - the world of future of wealth and job creation is not about Siemens, Rolls Royce or BAE Systems - it is all about the smaller companies.

The crucial struggle, Juergen explains, is in scaling it all up. "I do believe that as a UK manufacturing, engineering and innovation ecosystem we should be in a damn good place to scale up for the fourth industrial revolution. While the third industrial revolution - huge automated factories, massive robotics, large capital investment, very long term thinking (think your typical Japanese or German car manufacturers) - didn't lend itself to the way we drive UK manufacturing, the fourth revolution is about augmentation and less capital intensive equipment. In our factories we build in flexibility and agility, augmenting automation with human beings. We should therefore be in good place to do well in the fourth revolution."

There is also a sense that the country is beginning to care more about the creation of things. Generally we are realising that we need to support the making, creating and exporting of more things - whether this be manufacturing, software or augmented reality. Policy makers - excluding those sitting on the far right - are recognising the need for the Industrial Strategy and Public Private partnership.

Juergen is Chair of the Made Smarter initiative, which was spawned from the Industrial Strategy. This identifies four areas where UK manufacturing is struggling. Juergen explained for each what the movement is doing to make the necessary changes to step up:

1. Technology adoption - as Janet explained we are only at 13% digital readiness and are just not good enough at technology adoption. In Germany, 50% of SMEs are at Level 3 - and they think that is a disaster!



Professor Juergen Maier,
Chief Executive, Siemens plc

@advancedenguk

Juergen Maier at National Manufacturing Debate today with a positive outlook for UKs potential to do well in 4th Industrial Revolution. As a nation we are seeing again the rising importance of manufacturing.
#mfgdebate
#MadeSmarter

What are we doing? We've created a programme for supporting small businesses. A bit like the old manufacturing Advisory Service, its been recreated as a digital technology advisory service of some scale. With £20m funding from the Treasury, we are conducting a three year pilot in the north west. This started in January this year and early indications are brilliant - small companies are experimenting with technologies, learning and failing fast if that's what they have to do. Next we are looking to persuade the government to run similar programmes for all the major manufacturing regions across the UK.

2. Scaling up - We aren't good at scaling up the companies which are creating the technology that are the enablers of the fourth revolution - additive manufacturing OEMs like those seen in Germany or Japan. We have brilliant AI and robotics in healthcare and retail but are relatively weak in engineering and manufacturing.

What are we doing? We're working closely with HVM and the Digital Catapult to address the key technology challenges by setting challenges and technology demonstrators to work with SMEs to answer these important questions.

3. Upskilling - We should be less worried about the skills of our entry level people. Apprentices and graduates take to it like ducks to water, creating huge value in a relatively short space of time. We must focus on upskilling programmes in SMEs where there isn't enough ambition to do so.

What are we doing? Skills is the hardest one - we're struggling. We aren't detecting a real appetite to be ambitious about this. We need a national rethink on upskilling and the continuous learning environment. We aren't like Singapore, where every individual has to make a contribution into a training bank account which is matched by business and government to support continuously skills growth. France and Germany are launching similar schemes - but not here in the UK.

4. Leadership - we have fundamental issues at both at a national and company level.

What we are doing? We have strong gravitas around leadership at Made Smarter through a mix of SME and large companies. But we can't leave leadership to one person - leadership is about all of us.

Juergen ended his keynote with one call for action - to come on board with Made Smarter and the fourth industrial revolution. Help us invest in our own people and factories because our country needs it for economic success and jobs in the future.



Keynote 7

Innovation as a force for good and the need for great leadership were the themes of Terry's keynote - sprinkled with anecdotes from his military career as well as his time in industry.

With 2.6m people working in the manufacturing industry in the UK - 8% of our working population - contributing to 11% of our GVA, there's surely simple logic that the more productive, sustainable and successful we can make British manufacturing, the proportionally greater effect on our wider economy.

So, Terry asked, what determines the success of our manufacturing sector? It is of course technological innovation, improved productivity, competitiveness and improved skills, but as has been mentioned many times today, one of the greatest factor of all has to be leadership.

How do we ensure innovation is seen and perceived to be a force for good for our country? Here in the UK we enjoy liberal regulated systems of capitalism. But if we look at our political spectrum today that system is under serious threat of being demolished. Therefore we must manage technological change and get it right - and this has greater meaning today than it has ever done before.

Imperial College London has identified 99 key futuristic technologies - everything from human biohacking and smart dust to wireless energy transfers. This is tremendous but unless they can take this technology and push it out in terms of applicability for the 130,000 manufacturing companies, we will fail to deliver in this force for good. And crucially for success, these technologies must be fully commercialised to the point that it excludes any other competitors around the world - that's the tough reality of what we have to do. Reiterating Dick Emery's point earlier in the day, here in the UK we are good at finding the technology but not yet at commercialising it.

A recent study by the National Institute of Economic and Social Research identified the two biggest factors contributing to our poor productivity here in the UK are skills deficiency and poor business leadership. We need to put a phrase Juergen used some months ago, the 'make do and mend' mentality, in the bin once and for all.

Looking at current figures, it's not all bad news. The UK Manufacturing PMI number for April was 53.1% - down from 55.1% yet is in measurably positive territory - especially bearing in mind France and Germany are currently flirting with recession.



Terry Scuoler CBE,
Chairman, Institute of Export
and International Trade

Factory output is up 2.2% for first quarter - and while many will say this is because of companies stockpiling for 'No Brexit', even that isn't a bad thing, as surely they're showing their commitment to planning for the future. And last year was good for exports - 6.6% year on year increase - with exports making up 30% GDP. However we are still not an export intensive country if you compare the UK with Germany for whom exports contributes 48% to GDP. But we're moving in the right direction.

One challenge is our changing society - the increase in remote and part time working to meet the needs of our workforce. We also have a way to go in terms of diversity. And with the pace of technology increasing we need continuous through-life training for our workforce. It should not be simply before or at the start of your career.

The government's Industrial Strategy white paper, published November 2017, is well intentioned - new ideas, people infrastructure, business environment, places - but the government remains challenged. Brexit continues to be a distraction and so far there's only one city in the UK that adds positive value to wealth and GDP - and that is Bristol. All the others are negative contributors to the nation's wealth. So in answer to the question, is technology and innovation a force for good - of course, but it's in our hands to deliver it.



Keynote 8

Hannah started her presentation with her vision of the future - design and development will be decentralised; risk and uncertainty will be minimised in virtual worlds; factories will become self aware, hyperconnected and agile. The world will do business in a different way and value will be redefined and shift to less tangible assets.

At the The Manufacturing Technology Centre (MTC) in Coventry, Hannah and her team wanted to put their money where there mouth is and build a demonstrator of this future vision: The Factory in a Box (FIAB) - a disruptive supply chain solution enabled by industrial digital technologies. It is not a flat pack workshop in a box however - it's an actual smart factory that you ship to a location and start operating straight away. Rapidly deployable, remotely managed and monitored, a modular, agile solution, it has the potential to completely transform the way we do things. It means we can respond to wherever demand occurs.

Emerging industrial digital technologies provide the key to delivering FIAB - with these technologies already being deployed across different markets - particularly in entertainment (Netflix) and retail (Amazon and Zara - who recently moved their manufacturing back to the UK to respond to market demands).

What is the value proposition around FIAB - of moving your manufacturing capability rather than shipping your component? It's a potential route to commercialise your design, to maintain your IP and to maximise revenue. Product variation lends itself to local capacity - if your customer demand changes, instead of shipping it, you can make it locally, making you inevitably more responsive to your customers. By combining industrial digital technologies and disruptive supply chain solutions, we can give companies a rapid route to market, faster ROI and the ability to exploit new business models.



Dr Hannah Edmonds,
Technical Specialist – Digital
Engineering, The Manufacturing
Technology Centre

@MarkRJolly
Hannah Edmonds
@the_MTC_org
@HVM_Catapult talks
about Factory in a Box
concept for feasibility
manufacturing disrupting
traditional supply chains
giving local, rapid route
to market and flexible
response **@CranfieldUni**
@Cranfield_MFG
#MFGDebate

Dearman - Cryogenic pipe assembly fabrication for transport refrigeration units

Dearman's transport refrigeration unit (TRU) is built around a piston engine driven by expansion of liquid nitrogen and capable of replacing diesel-powered refrigeration systems for trucking refrigeration that produces no carbon dioxide or air pollutant emissions. Dearman required pipe geometries to fit multiple vehicles - what had previously been a slow manual process required an automated solution to support their distributed customer base. Using FIAB will allow Dearman to produce TRUs internationally, co-locating production with overseas vehicle manufacturers and integrators in developing countries. The digital twin functionality of FIAB enables Dearman to monitor and maintain production remotely, including optimising manufacturing schedules, local training and arranging predictive maintenance.

Not wanting the demonstrator to simply be a one off, Hannah and her team are building on the success, inspiring people to take elements of this and utilise to support their supply chain management. From the learnings of the FIAB demonstrator, the MTC developed the Smart Manufacturing Accelerator, which is essentially a framework to plan, design and build and operate, developed from. In light of how difficult it can be to qualify the tangible benefits of industrial digital technology, the FIAB demonstrator shows how we can make digital work for us a reality - demonstrating the benefits that disruption can bring and how it can positively influence your business.

Debate - part two

How can UK manufacturing create an 'ecosystem of success' for its supply chains?

Panel members:

- Professor Janet Godsell, Professor of Operations and Supply Chain Strategy, WMG University of Warwick
- Professor Juergen Maier, Chief Executive, Siemens plc
- Terry Scuoler CBE, Chairman, Institute of Export and International Trade
- Dr Hannah Edmonds, Technical Specialist – Digital Engineering, The Manufacturing Technology Centre
- Nicholas Ferrar, Patent Attorney and Director, Adamson Jones
- Tim Curtis - Senior Lecturer, Social Innovation, The University of Northampton



Rosa Wilkinson kicked off the final debate of the day: SMEs hear digital and think here comes trouble - It's going to be expensive and we won't get it right. What can we do to give smaller businesses the confidence?

All agreed that education and peer to peer networking was key.

Janet Godsell - Supply chains of the future require more planning and coordination. Many SMEs outsource the FD role. Planning is often one of the most under-developed capabilities in business - they need to think more long term.

Terry Scuoler - As well as creating better business networks its about having confidence. SMEs should build on what they are already doing - without knowing it they are already doing some of this.

Nicholas - In embracing digital we need to recognise that we all have to share more information that we used to - the question is, what are you willing to share and what's valuable IP?

Juergen acknowledged this being addressed through the Made Smarter movement, championing leadership, technology adoption and most importantly, telling and promoting good news and success stories of these initiatives.

John Churchill, Optimus Business Management Group
Q - How do the panel view pace of change as barrier to making change? Should I invest or should I pause and wait for the next great thing?

Terry Scuoler - Do not put off investment. In terms of culture and mindset of many of our businesses, we are underinvested. There needs to be a process as embedding new technology - this does imply some form of timeframe to get the benefits. My advice would be to invest sensibly and meaningfully - but don't always wait for next big thing.

Juergen Maier agreed - Go for it. The good news is a lot of the technology is now not as expensive and has shorter paybacks. But always make incremental changes and build on existing ideas. At Siemens we work on bringing innovation in from the bottom up - creating shop floor hackathons and trial experimental solutions.

Janet Godsell - Dyson always had an appetite to invest and was not afraid fail. It could be argued that Dyson is now so much further along in electric car technology because of their investment over 25 years in the motor. It has to be about the long term investment.

Referencing Richard's earlier focus on the volatility of today's environment, Martin Christopher always advocated structural flexibility - an option value approach to investment decisions. You can't simply look at how an investment in technology or otherwise, pays back now - we need make long term investments that give you most number of options in future.

Len Panet, Visage
Q - One of the pillars of Industrial Strategy is our people - two qualities we need for a sustainable supply chain and manufacturing are creativity and an appetite to accept failure - fail fast, repeat and try again. With politics focused elsewhere and education constrained, what can we do to support and invest in our people?

Tim disagreed with regards to education. He has seen change-maker skills embedded in the curriculums for secondary and universities education. There is a great deal of creativity coming out of schools and as an industry, we need to look for those skills - as they may not look the same as they did previously.

In addressing Len's mention of failing fast and repeat, **Nicholas** was concerned - he suggested that you don't see many SMEs failing fast and repeating - they fail fast and are generally dead. For OEMs this is more of

a luxury - some projects are successful but they can afford to fail. It is important to educate and foster successful supply chains to help SMEs take on that risk but successfully

Juergen Maier - We should push harder for more young people to do a professional vocation - and crucially see it as equal standing to the academic route. At Siemens we have some very creative people working in our UK factories. As a country we don't yet make enough of the transfer of knowledge between creative industries (gaming, design etc) and the manufacturing industry - but if we can, this creativity could form the USP of the UK for the fourth industrial revolution.

Terry Scuoler - It's the post 1992 universities - the old polytechnics - who are providing the resource for manufacturing. The yield loss from the Russell Group is still great. For me, if there was a magic wand that would change something unique to England and Wales it would be around subject choice at age 12/13. We are currently losing too many young men and women to the sector at that very young age.

Hannah asked for better PR around engineering - how do we make it more attractive to younger people? As we said before, the best and the brightest go into finance and not engineering. We need to give children a better understanding of what an engineer does and its breadth and diversity as a career.



@MarkRJolly

My Concord(e) moment was being amazed by my father's creation of an autonomous Spirograph in Meccano run with an electric motor and various cams!!! @CranfieldUni @Cranfield_MFG #MFGDebate

Bill

Q - At age 10 I saw Concorde and knew I wanted to be an engineer. What was your Concorde moment?

Juergen Maier - Juergen explained that he came to the UK in 1974 age 10. "Having been driven around in an Opel Kadett in Germany, I came here where my stepfather driving a Morris Marina! It was the most shocking piece of engineering and motivated me to want to make British engineering better!" While he admitted this was a little bit of a joke, it was still the truth!

Hannah had a love of physics but wanted to do something practical, a job with a purpose that would make a difference. That was her calling. For **Tim** it was first seeing the Mamod steam train - and for **Nick**, his moment was seeing his father getting his first work laptop - and the frustrations of the grayscale screen on which he couldn't get a colour video game to play. **Janet** found manufacturing engineering through an appreciation of her Sony Walkman - the wonder that is Japanese manufacturing. But she warned, be careful about using the title 'Engineer'. It can be rather stifling and we should embrace a blend of creative and business skills - the commercialisation brings it all together.

Terry - On joining BA Systems, seeing a stealth fighter jet on display at Farnborough Air Show, that could fly Mach 8 at 100,000 ft with no radar signal. The second was the technological drive he saw in British sport - from 1 solitary gold medal in 1988 Olympics to 20 gold medals eight years later - all through harnessing the excellence and skills of men and women both through training and technology. And in the automotive sector which is going through a challenging time at present, every Formula One car - with the exception of Ferrari - is built in the UK now. Sport is setting a great example.

John Patsavellas observed that today's theme was the supply chain ecosystem. He celebrated the community that we have become. However, he noted that actually technology was not the difficult part. The issue is people and collaboration - or lack of.

How do we find practical ways to get people to collaborate and get the win-win?

Juergen - The answer is to create these ecosystems. Here at forums like this everyone is using common language and talking about the Catapults.

There is an issue - companies are coming together to collaborate to find a technology solutions for many companies to benefit. But they still want their own IP as they're putting their own money in. We don't have the answer quite yet but are seeing a much stronger willingness to collaborate.

Tim threatened a little bit of controversy by stating the single unifying ecosystem model is wrong. Ecosystems are complex systems but are ultimately predictable as there are no humans in them - they're dynamic but always tend to roll back from changing. He suggested introducing humans into it and start thinking more around social and soft systems, reflecting the world as it really is. You bring humans back in and it makes the systems purposive and problem solving - intimately involving humans in the thinking helps create win-win.

For **Terry** the future of manufacturing will depend on people. It's not just about taking technology to business - take the application and the market with that technology to those out there who will be meaningful recipients of it. We also need to continue to break down the difference between academic white collar and apprentice vocational blue collar. It's still there. And finally, it is everything we can all do just to persuade people to invest. We are still as a nation very under-invested.

Janet, continuing to build on the people theme, explained that human nature is to collaborate for so long then 'shaft each other' - that's human nature. If we know that, we should minimise where you have to collaborate. Maybe the key is to only use collaboration when you have to - around a purpose or a project, and for stable demand, use digital technology.

Nicholas explained that we all need a mutual respect of IP. If you foster a culture of collaboration, that is undone when you put your single aims ahead of other people in the supply chain.

Hannah - The catapults are in a unique situation to share learnings from our outputs. We must share what we have done and in a lot of detail. We must set the example of sharing information.

As Rosa wrapped up the lively debate, she suggested it's relatively easy for us in the manufacturing community to agree. Actually to get to win-win, we need to take this conversation to other communities who are a necessary part of the success. Until we do that there will always be missing links.

In conclusion...

With thanks for a proactive and positive event from Sir Peter Gregson, Chief Executive and Vice-Chancellor, Cranfield University, he acknowledged that there is a need for universities to continue stimulate the type of debate seen today. Together with engagement between business and government, it is ultimately our absolute responsibilities to play a key role in this ecosystem.

Rosa reflected on recurrent themes throughout the day:

- **Skills gap** - Not just manufacturing and engineering skills, but also a call for our banks and accountants to have the skills required to help our businesses flourish.
- **Finance** - recognition that we need to start talking a common language with the financial community.
- **Softer themes like culture, people, collaboration** all need to come together so that organisations can work effectively
- **Technological innovation** has huge potential put here in the UK we need to learn how to commercialise and make it work in industry - and at all levels.

And finally we need...

- **Strong purposeful leadership** - Every speaker and panel member today is a thought leader. Every audience member is an advocate. The clear message to everyone in the lecture theatre and now reading this report - your job is not done - take this message to the world.

@john_pats

Following the #MfgDebate #ndm2019 @CranfieldUni the tidal words of our speakers and panellists reverberate and stoke our passion for #UKMFG underscoring the need for coordination of our efforts. We want to nourish the #EcosystemOfSuccess

@RMW136
@Chris_White_67
@Juergen_Maier

@Curtistim

Being provocative at #mfgdebate. Supply chains are not tidy or efficient. They are loose and baggy monsters of inefficiency. Will systems thinking help to tighten up the chains?



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Events

Manufacturing 2075
4 December 2019
www.manufacturing-2075.org

National Manufacturing Debate
19 May 2020
www.national-manufacturing-debate.org.uk