

Business, Energy and Industrial Strategy Committee

Oral evidence: Automation and the future of work, HC 1093

Tuesday 5 March 2019

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Watch the meeting

Members present: Rachel Reeves (Chair); Vernon Coaker; Drew Hendry; Stephen Kerr; Peter Kyle; Mark Pawsey; Antoinette Sandbach; Anna Turley.

Questions 1 – 99

Witnesses

I: Tom Bouchier, Managing Director, Fanuc UK; Brian Holliday, Managing Director, Siemens Digital Factory; Ian Funnell, Managing Director, ABB UK.

II: Jeremy Hadall, Chief Engineer, Intelligent Automation, Manufacturing Technology Centre; Nico Avdelidis, Chief Operations Officer, InnoTecUK; Dr Hayaatun Sillem, Chief Executive, Royal Academy of Engineering.

Examination of witnesses

Witnesses: Tom Bouchier, Brian Holliday and Ian Funnell.

Q1 Chair: Thank you very much to the three of you for coming to give evidence to our Select Committee this morning on automation and the future of work. We have two panels today. The first one is focused particularly on industrial automation, given your backgrounds and expertise, and the second panel, in about 45 minutes' time or so, is about new technologies.

This is the first of the evidence sessions we are taking on automation and the future of work, and it is something that the Committee are very interested in. We have done work looking at the sector deals and the Government's industrial strategy as well as undertaken visits both in the UK—we have been to the University of Bristol, the University of the West of England and the Sheffield Advanced Manufacturing Research Centre—and to Tokyo and other parts of Japan last year. Thank you very much for your time. We are looking forward to hearing what you have to say this morning.

Can I start, perhaps, by asking you, Brian Holliday, what automation technologies your business is providing to businesses? What are the most popular products, particularly in the UK market?

Brian Holliday: My business, Siemens Digital Factory, supplies software to companies to help them design products, factories and industrial processes. We supply automation technology: if you were going to control a process, perhaps you might use variable-speed drives to help control a conveyor-type application. We also supply cloud technology to help companies, when they are making things, connect to industrial assets and understand from data what is happening with those.

The most popular amongst those is the programmable logic controller. This is really the workhorse of industry. They are ubiquitous. They are everywhere, from small machines to industrial infrastructure like baggage handling and water and wastewater treatment, but equally you will find them in factories everywhere. They tend to be hidden away, but they absolutely drive industry.

Q2 Chair: How has demand changed in the last five or 10 years?

Brian Holliday: Demand has steadily increased, but not to the extent that we have seen in some of our neighbouring economies or those further afield that have really been focused on automation.

Q3 Chair: What countries have really upped their game and embraced the new technologies?

Brian Holliday: Our near neighbours include Germany, in particular, which has a real focus on what they have called Industry 4.0. Certainly it



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is evident in France and Italy, as well as further afield in Singapore and the US. Adoption levels for automation have considerably outstripped those in the UK over the last few years.

Q4 **Chair:** Tom and Ian, is that your experience as well?

Tom Bouchier: Yes, for sure. Fanuc manufactures something like 11,500 robots a month at the moment.

Q5 **Chair:** Where are they produced?

Tom Bouchier: They are produced primarily in Japan. What we do over here is build turnkey systems. We put the robot into a full system to go into manufacture the part. Even though the robots are coming in from Japan, the system is certainly British-made. Probably 5% comes in from Japan. The rest of it is all manufactured and made in the UK, so it is certainly a British system. We are finding that demand is quite high. Last year was our best ever year, and this year is proving to be the same. There is certainly a long way to go. We are so far behind Germany, France, Italy and Japan. We are the only G7 country with less than the worldwide average of robots. The worldwide average is 73, and we have 71 per 10,000 workers.

Q6 **Chair:** Why is that?

Tom Bouchier: Traditionally, we have been very slow at adopting automation. There is a very negative view of automation in the UK, and there should not be. We have to use automation to be competitive. If we are 30% less productive per hour than a German worker, we are not going to produce. We have to produce with automation; it is the only way to do it. We have to change. It is not so bad with some of other products like CNCs and injection moulders, but robots seem to have a very negative connotation when you hear them mentioned.

Q7 **Chair:** What were the other products you mentioned there?

Tom Bouchier: We do injection moulding machines; we do vertical drilling machines. We produce a range of CNCs for everybody else's machinery. Fanuc produces something like 250,000 CNC motors and drives per month.

Q8 **Chair:** What is CNC?

Tom Bouchier: It is computer numerical control. For anything that you are doing in terms of vertical drilling machines, lathes and all of the other equipment, some Fanuc equipment is in the background, controlling that machinery.

Q9 **Chair:** Ian, is your experience similar to that?

Ian Funnell: Yes, absolutely, and all for the reasons. ABB produces all the control systems that Brian has just described, whether that is for an individual machine, a production line, a factory or a UK-wide system. We make about 100,000 robots a year. They are made in Sweden and China, in the main. We have seen steady growth again last year,



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particularly from a robotics point of view. We also invested in quite a large automation company a couple of years ago, which was based in Austria. They have some facilities here in the UK as well.

Again, for the same reasons, I would go broader than just robotics, but automation is one of these things where there are a number of urban myths out there, which have to be busted. I mean in terms of how complex it is or not, as the case may be, how expensive it is, and the idea that for every system you put in place you have to displace workers. In our experience, that is absolutely not the case. There are some urban myths out there, which perhaps Government and the Committee itself should at least recognise and perhaps help to overcome.

- Q10 **Chair:** When you say that the products you are offering are not replacing workers, presumably companies buy this technology because it results in efficiency gains and productivity increases.

Ian Funnell: Correct.

- Q11 **Chair:** Would that not, at least in time, substitute for human workers?

Ian Funnell: In the main, most of the robots are put in place to do specific tasks that are repetitive, boring for people to do, perhaps dangerous, maybe lifting heavy loads and that sort of thing, or that require high levels of precision. In our experience, particularly for the SMEs, all the SMEs that I am aware of and all the ones I have dealt with have redeployed their workers to grow their company because they get efficiency gains out of the deployment of automation.

Brian Holliday: I would support that you automate to replace a task rather than a job. You have inherent value in the human operator, and you can use them on other value-adding tasks. In our case, in the 15 factories we have here in the UK, we are looking at automation to increasingly improve productivity. If you improve productivity and output, then you can be more competitive either inside the group when you are competing for capacity or against other firms globally that are looking to try to produce similar products.

- Q12 **Mark Pawsey:** I wonder whether I can ask about the benefits of automation to the country as a whole. Will it enable us to increase the size of our manufacturing base? In recent years, we have seen a resurgence in manufacturing, but over a much longer period our manufacturing sector has declined. Will the adoption of automation enable us to get back to the levels of 1950s or 1960s, for example?

Ian Funnell: In some cases, yes. If you look at the SMEs around—I focus on them, but I sit on the Made Smarter Commission and on the north-west pilot board as well—part of SME organisations automating tasks enables companies to produce more. As Brian has already mentioned, you can redeploy skills. If you look at it on a micro level, improving productivity at a micro level has a positive impact through the supply chain, whether they are sending to end users or they are part of a



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supply chain to a bigger organisation. Typically, better productivity means more predictability, higher quality and lower cost.

Brian Holliday: This has been recognised. Obviously, there were about 200 organisations that contributed to the Made Smarter report. It is fair to say we would ask for the Committee's support not only in viewing its findings but in supporting the ongoing activities of the north-west pilot. In essence, we found that there would be a net 175,000 job increase to the economy if we were to adopt earlier and have greater levels of automation technology or industrial digital technologies. We found that there was potential for a 25% productivity increase in industry and a net gain to the economy of £455 billion over 10 years.

The percentage of the economy that is made up by manufacturing is a more difficult topic, because you have to look at the definitions as well, but certainly the Manufacturing Technologies Association recently did some work that already indicates that manufacturing has a much bigger footprint than the 9.6% of the economy that we currently consider it to have.

Q13 **Mark Pawsey:** Tom, Fanuc are boosting my local economy by having their UK base in the Rugby constituency, but what are the broader advantages for the country as a whole of adopting more automation?

Tom Bouchier: As everybody has just said, we have to adopt it. I do not think it is a choice. Everywhere I go at the moment, it is not whether people can afford to do it; it is whether you can afford not to do it. We have to do it.

Q14 **Mark Pawsey:** What happens if businesses do not do it?

Tom Bouchier: We are not going to be competitive. We have to compete. We cannot put this automation genie back in the bottle somehow and say, "We are going to manufacture in one way and everybody else is going to manufacture in another way, and we are going to be competitive". We have to do it. All of the evidence suggests that there will be a figure there somewhere where it becomes automation against jobs, but we are so far behind that curve at the moment that we have years and years of growth before that ever becomes an issue.

Q15 **Mark Pawsey:** Brian, you said that we were 30% less productive than Germany. How fast do we have to add automation in order to get anywhere near the levels of our industrial competitors?

Brian Holliday: That is a difficult question to answer, because there is a very different sector makeup. I was struck by a very early report on this in 2011 by CEBR. If the UK were to at least catch up with the levels of automation technology in Europe's leading economy, Germany, we could improve by 22.3% back then. Of course, there is a strong bias towards transport equipment and automotive manufacturing, and those sectors tend to be higher adopters. However, there is no question that we have seen a correlation between automation and overall productivity in the



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economy. Made Smarter looked at food and beverages, the biggest part of the economy in manufacturing that could benefit the most, which warrants a look.

- Q16 **Mark Pawsey:** Are there particular sectors that you would say need more automation? There are some that we know have adopted it. We see adverts for car manufacturers with plenty of robots in those images, but what sectors are yet to take up automation?

Ian Funnell: As Brian said, food and beverages is certainly one sector. General manufacturing is another.

- Q17 **Mark Pawsey:** What is holding them back? Why are they not doing so?

Ian Funnell: Again, there is a lack of knowledge. If you look at the key outputs from Made Smarter, it is about leadership. Do the organisations understand this? Do they have the right skills to enable it to happen? Are they adopting the technology that currently exists? This is not a technology question. The technology is on the shelf in these sorts of companies today to enable that to happen. To get to where Germany is now, the technology exists. I would point the Committee perhaps to *The Economist* report on adoption. It talks about different aspects of skills and requirements, and whether the education system is correct to enable support for that for the next generation?

- Q18 **Mark Pawsey:** Tom, when I visited your site you told me that there were lots of businessmen who think that the cost of introducing automation is much higher than it actually is. Can you give us an example of a business that has benefited from this?

Tom Bouchier: That is something that we as an industry have not made very clear over a period of time. The return on investment can be quite low. Twelve or 15 months is quite a reasonable figure for return on investment for a big automation project. Some people are also of the opinion that robots cost what they cost 30 years ago. The cost of a robot now is a third of the price it was when I came into this business. It is an affordable technology. We have been very bad at getting that message out there. It is affordable and we can do it.

The big companies you have mentioned are quite capable of looking after themselves. We have to get the message further down that supply chain. We have to get it down to the smaller manufacturers. They are the ones that really need it. The big automotive companies of this world can look after themselves; they are quite capable of looking after themselves. We now have to get the message down to the smaller companies.

- Q19 **Antoinette Sandbach:** All three businesses represented here were started up or established outside the UK. Why have your parent companies decided to invest in the UK? Is that jeopardised by the current Brexit situation?



Ian Funnell: We manufacture a whole range of products from power systems all the way through to automation systems. It goes way beyond just the automation piece. Specifically on automation, the UK is generally under-automated. Personally, I see a huge market and huge potential in the UK. Therefore, there is no reason why organisations like ours—Brian mentioned this earlier on—would not continue to invest and grow in spite of Brexit, and we are continuing to do that.

Q20 **Antoinette Sandbach:** Are there challenges? At the moment how are you planning for an unknown scenario or two possible scenarios, a deal or no deal?

Ian Funnell: We have completed our planning. To be honest, I focus way beyond that. We are looking at the development of skills, how we can do that and how we can get diversity into the skills. You are speaking to Dr Sillem later on. She and I are working on engineering skills diversity, not just female diversity but general diversity across the intake. There are all these sorts of things that we are looking at. It goes way beyond 29 March.

Brian Holliday: For Siemens, we commenced commercial operations here in 1843, just for the record. William Siemens went on to become first president of what we call today the Institution of Engineering and Technology. Today, those 15,000 people are employed in what will soon become 15 factories when we have built Goole, which will build rolling-stock technology as well. Some of that is acquisition; some of that is organic growth.

We are very proud of our Congleton factory, which has been there since the 1970s. It builds 500,000 variable-speed drives with a really great local workforce. They are flexible; they are continually looking at improvement. We are able to deliver total cost productivity here through that combination of flexible workers, automation and the supportive environment we have, which outstrips other countries. When we are looking at investment decisions as a global company, you have to look at the regions where it just makes sense to invest. There are lots of us amongst that 15,000 who are trying to work on the attractiveness of the UK to keep those capacity considerations here.

Tom Bouchier: Fanuc is fully committed to staying in Rugby. We built the building there last year. We have just applied for planning permission for 25% extra space, because we have already outgrown the building that we have. As I said earlier on, 10% of what we bring in is from Japan; the rest of it is locally made. Currency fluctuations could cause a bigger problem for me than Brexit, whatever the tariffs are. The 10% we bring in is not going to be a factor in when we do it.

With 75 million people in this country, we need to grow manufacturing in this country. There is enough for me to concentrate on in here to keep this going forward and certainly to outlive me. There is an awful lot of growth. We are lucky. I do see it in the same way as everybody else.



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There is potential there to grow. We are lucky in some ways that we do not have too many legacy systems. There is not too much old stuff out there that we need to replace. We are in a position where we can go from not very much and adopt it very quickly, if we can get that message out there that it is the way to go.

Q21 Peter Kyle: Brian, in your opinion, what can Britain do to differentiate itself from other markets in terms of producing automated products?

Brian Holliday: We probably have to look at incentives to improve this adoption curve. If you do compare us with Germany, you will see not only a high uptake of automation technology there but a machine-building sector that generates a huge jobs footprint as well. We have largely lost that. Over the course of my career, I have seen a lot of those machinery builders—the printing companies and wrapping and packing machines—disappear to Germany, Italy and further afield. There is a huge amount we could do to send a message to say that automation is important and that we should be investing in the skills and the technology to help rebuild that sector. Historically, I am sure you will all recall in the first industrial revolution—

Peter Kyle: I am not that old.

Brian Holliday: We had the machine builders and we prevented technology and talent from disappearing from this country. I am not suggesting a return to those protectionist ways, but we have to recognise the importance of automation to productivity and the wider economy is an important link to make.

Q22 Peter Kyle: Ian and then Tom, I am wondering whether there are any aspects of robotics and automation that Britain should or could be leading on, for example health and social care. When we visited Japan, we saw huge amounts of investment in that area. Clearly, they have an ageing and shrinking population and so therefore there are lots of issues about how to care for people living into old age and extreme old age. There is a lot of investment there. Are there parts of sectors here in the UK that are specific to the UK where we could be taking a world-leading view on?

Ian Funnell: There are some sectors where we already have a world-leading position. In AI in particular, there are so many start-ups and so many fantastic organisations developing AI solutions, which then feed into the automation process. Developing and supporting that sector is really important. That comes from start-ups and university spin-offs. There are so many sources of innovation. It is about being able to harness that and then commercialise it.

In terms of incentives, if I take the Treasury view, lifting minimum wage is one thing. If you make labour more expensive, there will be an incentive to automate. That is a valid strategy, but for me that is a push strategy. The pull one is about what the incentive is for the organisations to adopt any of those technologies. How do we incentivise them to make



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that big step? Once that step is made—it may be a modest step—there is no going back. Companies just continue that journey. It is making that first step that is the most critical.

Q23 Peter Kyle: You say “AI”; that is interesting to hear. Is because we have such a mature and advanced higher-education sector here? We have the golden triangle and other hubs.

Ian Funnell: We do. There are all sorts of reasons for it. We do attract a lot of foreign students and companies to these shores specifically on AI. That is the general direction of travel for all automation systems: learning from what the systems and processes do in manufacturing and feeding that back to the automation system so that the systems themselves learn. It is straightforward.

Q24 Peter Kyle: Tom, is this the sort of thing that Government should be involved in? What can Government do and what should businesses or Government be doing in this area?

Tom Bouchier: As we said earlier on, Government maybe need to get a little bit more pragmatic in some of their help and get it further down the supply chain. As we have just said, we have some current world leaders in a lot of AI. Some of the Catapult centres, which you are talking to later and which we have dealt with, are working in these areas.

Q25 Peter Kyle: What are the barriers to growth?

Tom Bouchier: The answer needs to be twofold. We need to work on the longer term and what is coming out in the next few years, but we also need to work on adopting what we currently have. If we do not adopt current technology, we are not going to be in a position to adopt this technology in four or five years’ time. We have to start straightaway, and we have to start upskilling people to be able to adopt the technologies that will be coming out in the next few years. It is down to education and we do need to upskill. The key to all of this is upskilling.

Q26 Vernon Coaker: Picking up on that, Tom, to what extent are you all able to recruit the people you need? Are you able to recruit? Is there a real problem here? What skills are the three of you specifically looking for in your areas?

Tom Bouchier: Yes, we can recruit. There certainly are shortages. It is starting to become more evident that there are shortages.

Q27 Vernon Coaker: Which are they? What are the shortages?

Tom Bouchier: We need to make people aware that some of these STEM subjects, manufacturing and engineering, are viable career paths to follow. We have forgotten that over the years. Coventry, where we are based, was a manufacturing hub. There is very little there now. We have lost that. There were 10,000 apprentices in Coventry in the 1960s



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and 1970s. There are a few there now. We need to grow the skills level. We really need to get down to that level.

Vernon Coaker: I totally agree with that.

Brian Holliday: Lloyds Bank, in their report of March of last year, identified technology skills, leadership skills and data skills as the top three most difficult to recruit. That chimes with our experience, particularly in the automation space where we do not seem to have had the demand-led system work for our universities and FE colleges to proactively train in control systems, for example. There are some really good examples, in Middlesex and Salford, where we have some great schemes, but we are not seeing the input side address the overall problem. Our big challenge is getting people who can program a control system or think about, as today is developing, an IT strength for us in the UK, thinking more about the virtual design of machines and plants and then translating that into a control system that you would design and build. Those are the key skills we really need. They are mechatronic skills, if you like. There is a desperate shortage of those people.

Ian Funnell: Again, it is very similar for us. We are not looking for code writers. We are not looking for individuals who can write base software codes, typically. We are looking for those who can apply the technology that exists into different situations, into a food and beverage factory or into a general manufacturing factory. It is those application skills that we sometimes struggle with.

Q28 **Vernon Coaker:** I agree with everything the three of you have said. What should we, as a Committee, recommend? What part should you play? What part should business play? How do we get more women involved? It would be interesting to know what the stats are with respect to women and the recruitment of young women into the industry. What should you be doing and what should we be doing?

If we had been here five years ago, I suspect the three people who would have been sat there would have been saying exactly the same about the lack of skills and apprenticeships. Ten years ago it might even have been the same, though it may have been in a slightly different context. What are we going to do to make sure that in five or 10 years' time, the next BEIS Committee or the BEIS Committee after that do not have three people sat here saying that we need more skills, apprenticeships, vocational training and women into these areas? What is it that is going to make the difference? Nobody is against any of that, but it never seems to happen.

Ian Funnell: This last year we increased our apprentice intake fourfold. I was with them all just before Christmas time. Out of all of them, there is one girl.

Q29 **Vernon Coaker:** That is one out of how many?



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Ian Funnell: That is one out of 54. I challenged the principals of the colleges.

Vernon Coaker: It is not a criticism; it is just a fact.

Ian Funnell: Yes. I challenged the principals of the colleges. We get some fantastic students. Their challenge back to me was, "I do not get any intake from girls then, and therefore I cannot give you an output". One of the things we started a couple of years ago was a very simple thing in primary schools. It is called VEX Robotics. It is a Meccano set, and you get a challenge. You can roll this out into schools. It is not expensive to do, but it is very engaging. The interesting part of this is that the majority of those who are engaged are girls, not boys. I am talking about six, seven, eight and nine year olds. .

Vernon Coaker: It would be interesting to track them to see what happens.

Brian Holliday: Yes, indeed. Hopefully that enthusiasm does not get killed off in secondary school.

Brian Holliday: I concur with the notion of starting early. The work that the Royal Academy of Engineering is doing in this space in particular, This is Engineering, to encourage young people to think about engineering careers, is superb. You will be aware that the average is 9% in terms of the manufacturing sector. We are outstripping that in terms of our overall female-to-male ratio.

Q30 **Vernon Coaker:** Can you put a figure on that? When you say "outstripping", what do you mean?

Brian Holliday: We are at roughly 12% at the moment, and our current apprentice intake this year in my division is 23%. What is key to that is signposting the opportunity and having role models: girls who then appeal to others, rather than a businessman in a suit.

I have seen some really great examples. MBDA in Lostock is another example of a company that has invested heavily in taking on a 50:50 ratio of male and female apprentices, so it can be achieved. There is a significant role for Government in this. Perhaps to highlight the Made Smarter Commission, there is a role there specifically for helping not just innovation signposting but skills co-ordination, because we have such a fragmented skills system at the moment. It seems broken and complex.

Q31 **Vernon Coaker:** It is too fragmented at the moment.

Brian Holliday: Yes, absolutely.

Q32 **Vernon Coaker:** There are too many people responsible and nobody responsible.

Brian Holliday: Yes.



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Q33 Antoinette Sandbach: I just wanted to come in on your idea about VEX Robotics. You are based in Warrington. My constituency is a Cheshire constituency. Given that you are in Cheshire, on the doorstep, how many schools in Cheshire actually have this? How do I promote this to my head teachers and my teachers so that I can encourage girls to go in?

Ian Funnell: We can talk about the detail later for sure, but it is so easy to do. You do need the support of the teachers or, in some cases, the parents, who are then promoting this. Whether it is for girls or boys, it does not matter. It needs to be a broader community rather than just the teachers themselves. The output has been surprising for us. As I say, at least 50%, sometimes much more than that, of this is engaged by girls rather than boys. When we take robots around to schools or other locations to show people, you can program them on an iPad these days. It is not difficult to do. Therefore, the girls will be engaged with that. They say, "I want to be a robotic programmer, because you can do it on an iPad". It is not that complex. If primary school children can do it, anybody can.

Q34 Antoinette Sandbach: You have been running the pilot in the north-west.

Ian Funnell: No. You mean Made Smarter, yes.

Q35 Antoinette Sandbach: There is a Made Smarter pilot in the north-west. We went up to Sheffield Advanced Manufacturing Research Centre, and we walked into the apprentice training centre. On the wall was a photograph of probably about 500 men. I think there were three women in it, slightly hidden. It did not look like a very welcoming place for women. How is Made Smarter tackling this? Women are half the workforce, so how is Made Smarter looking at that? I understand that girls are interested at nine, but there is something happening between nine and 16.

Brian Holliday: On Friday, there were the Apprentice of the Year Awards at the AMRC Training Centre. There were some inspirational female winners, by the way, so it is not quite as bad as just two. That is a fantastic backdrop. I did not see any difference in the way anyone was treated through that process. It is about generating those sorts of role models. Maybe we could all do more to shine a light on the fantastic careers they are already having.

You are right that access to 50% of the available workforce to help with the skills shortage is key. As companies, we all want to do the right things, but there is a lack of a co-ordinated way of engaging with schools. We need to go in early to try to engage in rollercoaster challenges or the Greenpower Education Trust, which engages girls. A super example of that, if you have the chance to look at it, would be the University Technical College in Bolton. Again, we need projects that engage equally, regardless of gender, in these sorts of innovation challenges. As employers, we cannot do enough of that to help. If Government were



playing a role in this, it is signposting the mechanism and encouraging companies to get more engaged.

- Q36 **Antoinette Sandbach:** Just quickly, where skills has been devolved, have any of you engaged with the metro mayors or places where devolution has taken place and there is a devolution of skills to say, "We need a) to open it up to women, and b) to have training locally"—you have all mentioned skills—"that fits our business and promotes the opportunities that we have"?

Tom Bouchier: No, not with the metro mayors, as far as I am concerned. We have with the Scottish Government, yes, but not with the metro mayors yet.

- Q37 **Vernon Coaker:** Good luck with the work on bringing more young women into the sector. It would be interesting to track that. I was particularly taken by the point about the fragmentation and the lack of a co-ordinating voice to try to drive it.

Tom, can I move on to something else? You have already spoken about how automation adoption is lower in the UK than in many of our competitors. I was struck by one figure I saw somewhere about the number of robots we have compared to Germany.

Tom Bouchier: It is 73 per 10,000, and they have 309 per 10,000.

- Q38 **Vernon Coaker:** That is a colossal difference. Can you say something about why you think that is the case and what we can do about it? We are very interested, as a practical Committee, in what we can do. We can describe the problem, but what do we do about it?

Tom Bouchier: It is about getting to those smaller companies to grow it. The adoption rate in Germany amongst the smaller companies is much higher than over here. In the automotive companies and the pharmaceuticals, it is probably about the same. In the smaller companies, it is much higher. They do have a far more automation-savvy management over there, who are willing to adopt it. They do have a longer-term view on production. We certainly sometimes are still guilty of having a 12-month budget and that is as far as anybody is looking ahead. We do need to get out and change those views within companies.

A lot of it is to do with getting that message out there. We need a co-ordinated approach. We have done the same with education. Everybody is doing their own bit in industry. Each of the companies is doing the same, each of the local authorities and each of the areas. There does need to be a joined-up approach.

Brian Holliday: To add to that, yes, there is definitely short-termism. There is a lot of "make do and mend". We think we are doing the right things in industry to keep the older technologies going. There is something in looking at our near neighbours, who enjoy Government



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incentives. This has not been entirely market-driven. There are adoption incentives for automation technology in France and Italy.

- Q39 **Vernon Coaker:** What is it that has been available in other European countries that has made a significant difference to the amount of investment in terms of automation? What is available in other European countries that is not available here?

Brian Holliday: Industrie du Futur in France is a good example that was automation-specific.

- Q40 **Vernon Coaker:** What is that?

Brian Holliday: It looked at the average age of machines in French factories and identified them to be about 20 years old. That surprised me, because the average machine here is considerably older than that. What we tend to have in comparison is advance capital allowances or we have an investment allowance, but it is a blunt instrument. It is not specifically around automation. It does not say, "If you invest in productivity-enhancing technology, you will get an incentive for that". Companies like patent box and R&D tax credits—they are great—but they are not incentivising companies to invest specifically in automation.

- Q41 **Vernon Coaker:** It is not only having investment incentives to automate; it is having the right investment incentives to automate. An example you have given is looking at it not just as a pot of money or a tax break but, essentially, around what the average age of a machine is.

Brian Holliday: Yes, absolutely. Specifically, we have an enhanced capital allowance regime that incentivises the use of low-energy technology. Variable-speed drives and motors consume the overwhelming majority of energy in industry, so we incentivise their use to reduce energy but we do not incentivise anything that is productivity-enhancing in industry.

Vernon Coaker: That is really interesting.

- Q42 **Mark Pawsey:** I was just going to ask about the flexibility of automation. One of the reasons why businesses may not want to invest in automation is that there is this perception that it is only applicable to one task and labour, of course, is much more flexible. To what extent is the automation that is available to businesses today able to be adapted to another function if the first function is no longer necessary? I know that is something you have spoken about, Tom.

Tom Bouchier: Current automation is far more flexible. Robots are now so flexible. Collaborative robots are very flexible. Robots now work with people. They are not there to replace people; they are there to work with people.

Brian Holliday: I would say that automation is the only way we can cope with the complexity of the future, so we are building 17,000 variants of our drives. You need the combination of IT and automation.



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Q43 Mark Pawsey: In the same way as how businesses do not know how relatively inexpensive automation is, is the perception of the businessmen you are talking to that, if they buy an automated solution, that is the only use it can serve?

Ian Funnell: There is a perception.

Q44 Mark Pawsey: How do we and you change that?

Ian Funnell: That is a joint role between business and Government. We can tackle that on an individual SME-by-SME basis, but it is going to take us a long time to get through the SME population in this country. Through national Government, LEPs, the metro mayors or via whatever mechanism, the message should be constant. It could be something like Made Smarter, which only launched officially on 1 January this year. We have already signed up something like 140 businesses in the north-west. They are looking in detail at automation for their businesses. In two months, that is a great start for a project like this.

Mark Pawsey: It is signposting the success stories.

Ian Funnell: Yes, absolutely.

Q45 Drew Hendry: I want to pursue the line that Vernon Coaker was raising with you just a moment or two ago about Government incentives. Are the Government providing the right support for businesses and sectors that want to automate? If I can go further from that, has the Made Smarter Review made a difference yet in encouraging greater automation?

Ian Funnell: It is a great question. Part of Made Smarter is about providing the expertise to manufacturers to see how they could automate part or all of their systems. There are advisers who will go to these companies and talk through their production processes and make suggestions as to how they could be automated. Showing and telling is the best way to do it on the ground. That could then be supported by appropriate incentives. I agree with Brian that it is not necessarily about capital allowances; it is about productivity improvement incentives. If you are able to improve your productivity, you get the incentive that is attached to that. Those two work hand in hand.

Q46 Drew Hendry: Could you give an example of the kind of incentive you are talking about?

Ian Funnell: There is a company we were dealing with in the north-west—it is a small company of three people—and they paint doors for kitchen cabinets and bathroom cabinets. It is a very basic thing. They had an opportunity to win a large contract, and they decided they could not do it with three people and were stuck. They took advice. They put in automation for their production line. They are now one of the largest producers of painted doors in the UK. They employ nine people now, as a result of that. The growth for them has been phenomenal. There are so



many examples, literally from the north coast to the south. Committees like yourselves should go and see what these people do. There are fantastic stories out there.

Brian Holliday: Perhaps I could pick one of the policy instruments that helped address this in the recent past, which was the Advanced Manufacturing Supply Chain Initiative. It was a short competition window, but it was one we participated in to try to help to improve the productivity not of our manufacturing plant but of the smaller companies that were supplying technology to us. We have certainly seen significant progress made, but of course that was a short-term incentive; it did not exist in the longer term. The fact we are seeing such great interest in the north-west pilot for Made Smarter suggests that the lack of an manufacturing advisory service, which was there before to provide handholding support, particularly to smaller companies that did not have time or knowledge of the benefits, is tremendously important.

I would make one other point, which is just crucial, about something the industry has really benefited from. That is the seven High Value Manufacturing Catapults. They have done some tremendous work on SME outreach. Some 40% of the activity of the Advanced Forming Research Centre, I found out last week, relates to small-to-medium enterprises. I know that is very similar now for the Manufacturing Technology Centre in Coventry and the Advanced Manufacturing Research Centre, which are increasingly engaging with the long tail of manufacturing companies too.

My ask is for us to maintain that core funding. The model works—the “one third, one third, one third” model for collaborative R&D and industrial investment. It needs to be there in the long term. We cannot make that a policy instrument that changes if we change Government.

Q47 **Drew Hendry:** I am going to come on to Catapults in a minute or two. Tom, what else would you like to see the Government do to encourage businesses that want to adopt automation?

Tom Bouchier: As everybody has said here today, something to do with productivity has to be the key to this. Your first question was, “Have the Government put in the right support?” Even though I cannot say why they have not, the results show that they have not and that we do not have the right support out there, because of the level of automation we have.

The productivity side is the side we have to focus on. If we produce more and we make more, we have to be more successful. We are so far down that chain. The work now, certainly at the MTC in Coventry, across the road from me, is great. We have two totally different ways of attacking the same problem from early adopters through to current manufacturers, and we need to do more of that around the country as well.

Q48 **Drew Hendry:** Let me just ask you all this. Would you like to see a



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robotic sector deal, for example? Would cross-cutting policy on industrialisation and automation make more sense?

Brian Holliday: Perhaps I could tackle that, as the co-author of the robotics and autonomous systems sector deal proposal.

Drew Hendry: That seems reasonable.

Brian Holliday: We have to be a little bit careful. We did identify looking at prospective sector deals for manufacturing, robotics and autonomous systems—as you know, one of the eight great technologies—along with AI. I know we are describing Made Smarter as horizontal rather than a sector deal, but it would be fantastic to get some support for manufacturing and the uptake of technology within that as part of Made Smarter. We have a commission now.

Q49 **Drew Hendry:** Is Made Smarter lacking that focus?

Brian Holliday: No, Made Smarter is really in its early stages of implementation. That is what really needs our support in industry. In the RAS community, we had identified that, yes, we could build on our innovation strengths in particular, but we equally found that the uptake and the adoption of technology is the key issue. For right now, where the real focus is—this is where I would argue it should be—is around Made Smarter. Let the commission do its work to look at the skills, adoption, leadership and signposting challenges that it is trying to address right now. Let us give it all of our support.

Q50 **Drew Hendry:** You seem to be suggesting that it has a long way to go to meet its objectives. Would you agree with that, Ian?

Ian Funnell: It has started on the journey. If you look at the Manufacturing Advisory Service, which was there in isolation, on its own, it helped, but it did not help as much as it could have done. Breaking automation down into its component parts is unhelpful, for example something specifically on robotics. This is about automation of systems, not just particular components that fit into that. The more we have the advice, support and structure that can be focused within manufacturing, the greater the opportunity for UK plc.

Q51 **Drew Hendry:** What research and development investments are your businesses making in the UK? Is enough being done to develop new automation technologies?

Ian Funnell: Most of what I call our core R&D activities are offshore to the UK. 25% of our R&D is what I call blue sky: it is new materials, new systems and new process. It is completely blue sky. A lot of what we do is application R&D, so that is about applying existing products into new locations or new applications. We do a lot of that. A bit like Tom's centre, we take robots from China or Sweden and we then produce manufacturing cells in our place at Milton Keynes. That is about how to



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apply robotics in different scenarios. That is where most of our R&D goes.

Tom Bouchier: Fanuc spends about £330 million a year on R&D worldwide. A lot of that is the application stuff over here. It is about trying to convince manufacturers of what robots can do. We bring them in to show a robot doing food tasks or to show it working the whole way across the full industry spectrum of what we can do with each of those robots. We will do the application stuff over here. We will leave the R&D on the new products to the HQ in Japan. It makes sense to have that in one place.

Q52 **Drew Hendry:** How engaged are you with the Advanced Manufacturing Research Centre?

Ian Funnell: In one word, I would say “very”.

Drew Hendry: It is nice to get a straight answer.

Tom Bouchier: We work more with the MTC in Coventry than the AMRC.

Q53 **Drew Hendry:** I said I wanted to ask more about the Catapults, and that is why I am asking that question. Are the Catapults effective? Are they driving innovation in your sector? Should there be a specific innovation Catapult?

Brian Holliday: They are driving innovation. They are really helping with the signposting. They are helping to create communities. They are a meeting space that is tremendous for companies to get together to solve problems. You get such diversity of thought there. You get people from very different backgrounds, very bright people who come along and who love to solve problems. It is exactly what we have been missing. One of the engines for innovation growth in Germany has been the Fraunhofer institutes. There are around 70 of them. We now have seven cathedrals for manufacturing in our Catapults, which have just been fantastic. Anyone who engages will give you that feedback. They have practical advice, projects that can be undertaken and people they can connect with. That has certainly been our very positive experience.

Drew Hendry: Thank you very much for all your very straight answers.

Q54 **Anna Turley:** One of the things we are particularly interested in is the implications for the future of work. Brian, your evidence to the Committee claimed that two-thirds of children in primary school today will work in jobs that do not exist yet. How on earth can Government and business even begin to prepare for that challenge and how should they be going about that?

Brian Holliday: Absolutely. I gave evidence to the Education Select Committee just recently highlighting that we need to do much more on teaching our children to think, to be creative, to be innovative, to work on communication skills and teamwork. It is evident that you can draw a straight line from the recent past to today, where we are employing people in jobs that simply did not exist—cloud analytics and data science



that we are using today, edge computing, some of the things that we now see as normal—and that is on the back of devices like mobile phones and iPads having a thousand-fold increase in performance over the last 15 years. This is people and machines that are interacting in an unprecedented way, so if you look to the near future and some of the things that we will be using technology for, we have to work on the ability to adopt, embrace and learn better than perhaps we have today.

There is a huge proportion of the current workforce who are already in the world of work, who could potentially be disrupted by this innovation. It is happening regardless of whether we are pushing it or not, so there is an element of teaching our kids to embrace a future of constant change, but there is also a need for us to up-skill current workers; we estimated about a million in the report. That is where, as companies and Government, we need to have a proper mechanism to retrain and up-skill, not just a levy that looks at entry level but at retraining within companies to adopt and embrace new technologies.

Q55 Anna Turley: Staying on that point, Tom, in the workforce at the moment many people are already very nervous, not just those in repetitive and technical work; a lot of people are regularly told in studies that their jobs are at risk of automation. How seriously should people take that threat, how imminent is it and what does that revolution look like in the workplace?

Tom Bouchier: There are very few people whose jobs are currently at risk of automation. There are a lot of people with the potential to grow with automation and we do have to accept that maybe some of the more manual, repetitive tasks will go, but they will be replaced by other tasks. Which tasks they will be, I am very wary of experts and futurists and everybody else; everyone has been wrong as far as I have seen. We know there will be new tasks out there, but if anybody says they know what they are, I do not believe them. We have to get rid of that negative perception.

Going back to education as well, we have some fantastic educational facilities the whole way through primary, secondary, tertiary—every education facility. There are some not so great ones as well, and we do need to stop teaching the innovation out of kids in that middle period. People talk about primary school girls coming in. We probably get 20 schools coming in and there is no difference between boys and girls: they both love playing with the robots, they both know what to do with them and it is natural. Then we seem to spend six or seven years teaching innovation out of them and then trying to put it back into them when they get to 16 or 17. We need to stop that. We need to keep the fact that they can innovate, they can try things and they can learn things. We need to really make that key in all the education facilities. I am sorry; I know that was not the answer to the question, but I wanted to say that a minute ago.

Q56 Anna Turley: That is really helpful, thanks, Tom. I would like to come



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back to the point you made about new jobs that are evolving and what could replace them. Ian, to what extent do you expect jobs that have been lost to be replaced by new jobs? I think it was Deloitte that said that for every 800,000 jobs lost they are replaced by 3.5 million. Do you think that is realistic?

Ian Funnell: If you look at the economies that have been heavily automated over the last few years—the South Korea and Germanys of this world and the ones that are much further down the automation track than we are—employment has increased, not decreased. If you take it at a macro level, that is absolutely true. In order to cope with that, it is much more about teaching the next generation active learning and the behavioural skills. It is not the technical skills. It is the fact that many who will come into employment in the next decade will not have a single career; they may have five or six different careers. To answer your question about what on earth Government can do, it is anticipating the fact that retraining and re-treading is going to have to happen on a much more regular basis than it does now.

Chair: Thank you very much. Thank you to all three of you for coming to give evidence this morning, it has been fascinating and really helpful for our inquiry. Thank you very much.

Examination of witnesses

Witnesses: Jeremy Hadall, Professor Nico Avdelidis and Dr Hayaatun Sillem.

Chair: Thank you very much to the three of you for coming to give evidence this morning. I think you were all here for at least some of the previous session, which I hope you found as interesting as we did. We have a number of questions to get through looking specifically, with this panel, at new technologies, reflecting your more academic experience at different institutions and academies. Mark Pawsey will start the questioning.

Q57 **Mark Pawsey:** We have heard the evidence from businesses involved in the sector and I would like to ask you, from your perspective, why businesses should consider automation. Jeremy, because you are the second witness to be based in my constituency, I invite you to go first.

Jeremy Hadall: I am not going to disagree with any of the comments that were made in the previous session. From my point of view, the reasons for automating are fairly clear, as previous people have also made clear. It is about, yes, you can get more productivity. It is about getting more repetitive levels of higher quality out of the system. It is about taking people out of dull, dirty, dangerous jobs and, for me, that is one of the biggest aspects. It is taking people away from jobs that are repetitive, dangerous and in challenging environments, and putting robotics and automation into those places where it enables people to



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have a high quality of life through their employment. For me, those are the biggest gains from robotics and automation.

Q58 **Mark Pawsey:** Dr Sillem, from your point of view, what are the key drivers pushing businesses towards automation?

Dr Sillem: I will just build on Jeremy's comments rather than reiterating them. In addition to those points, environmental gains are also worth thinking about, as well as competitiveness. Framing this all in terms of competitiveness is incredibly important. It is not just about efficiency; it is also about the ability to drive new revenue streams and business models. If you are a business that fails to take advantage of those opportunities, your competitiveness is put at risk if your competitors do.

Q59 **Mark Pawsey:** Nico, what is your perspective?

Professor Avdelidis: Automation, autonomy and robotics in general, apart from manufacturing, can help in different areas when making inspections and monitoring of large structures, so you have safer structures. The ability of automation in this kind of inspection and monitoring can help the area of the inspector or the engineer.

Q60 **Mark Pawsey:** We heard from the earlier witnesses that if we do not innovate and introduce this technology, we are in real danger of falling behind. How dangerous is that, and do you get a sense, Jeremy, from the businesses that the MTC operate with, of an appreciation of the urgency?

Jeremy Hadall: The businesses that we work with at MTC are starting to realise that innovating in this area and, to the previous witness's point, adopting the existing technologies we have is becoming almost not a question; you have to do it. If they do not adopt and if they do not innovate, we will fall further behind. We are already behind, as has been said, and if we do not start that journey now and help companies to go down that path, we will continue to fall further behind.

Q61 **Mark Pawsey:** Nico, at InnoTecUK you are developing new products. You have focused on the three Ds, which Jeremy spoke about earlier, dealing with the roles that are dirty, dangerous and dull. Is that where you see the key priority, or are there broader issues?

Professor Avdelidis: It is one of the key priorities. When we started as company about 10 years ago, we started as a spinout company from South Bank University in London. We now have about 42 employees doing research and development of projects and trying to make products that penetrate the market, mostly in robotics and automated systems that can help on inspections. There is a trend in the last year or two to also be involved with dangerous environments, so this is one of the key priorities for us.

Q62 **Mark Pawsey:** Can you explain a little bit about how robotics can help in a dangerous environment and why it is so important?



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Professor Avdelidis: As a company, we have projects that are involved with the oil and gas industry. Sometimes this is a dangerous environment for an inspector to go into, so a robotic system equipped with different kinds of sensing capabilities can do the inspection without there being any risk to the human factor.

Q63 **Mark Pawsey:** To follow that, Dr Sillem, previously we have understood robotics to be fenced off and operating in a totally separate environment, but increasingly robotics are working with people. Can you tell us about how that development is taking place?

Dr Sillem: Sure. Co-robotics is one of the key trends and often slightly missed when we talk about robots taking over. It could be in a health and social care environment or in a factory. In fact, there are many factories—I am sure you will have seen some of them—where you have great examples of co-robotics improving efficiency, but also improving people's experience of working in that environment. The concept that human beings need to be at the centre of the fourth industrial revolution is a really important one to bear in mind.

Q64 **Mark Pawsey:** Jeremy, one of the concerns we have heard expressed is that the UK has relatively low wage costs and the cost benefit of introducing robotics is disadvantaged by the fact that labour is relatively inexpensive. Are low wage costs holding back the take-up of automation?

Jeremy Hadall: It is a factor, but in our experience at MTC, it is one that is quite sporadic across sectors. I am not saying this is the only factor, but in the food and drink industry it is a particularly prevalent factor that the low wage cost that a food producer can pay seasonal staff is difficult to offset against an investment in a robotics system. If you go to what I was going to call a higher value manufacturing environment, but what I mean by that is, say, the aerospace industry, it is a much easier argument for automation against the wage cost.

Q65 **Mark Pawsey:** The evidence from our previous witnesses is that those highly visible, big manufacturers have already done it. Is that your experience?

Jeremy Hadall: Yes.

Q66 **Mark Pawsey:** Is there a long tail of SMEs that need to be thinking about automation but are not yet doing so? How do we encourage them to consider taking up automation?

Jeremy Hadall: You are absolutely right. There is a huge tail of SMEs that have not even thought about this yet. Again, to repeat the previous witnesses, it is about knowledge, awareness, helping them with financing and with the right skillsets in their employees to not only install the equipment but also to maintain it and run it.

Q67 **Mark Pawsey:** Dr Sillem, do you have views about how we can



encourage small business owners to think more broadly?

Dr Sillem: Sure. When we look at the long tail of relatively low productivity companies, we need to be clear that we are not necessarily speaking about all of them, but there is that tier that is just below those that have already adopted and have high productivity that we can help to bring up into that higher productivity category. Sometimes the conversation gets a bit conflated about who we are targeting. For every single SME across the country, trying to convince them that Made Smarter is for them or that industrial digitalisation is going to change their lives is not necessarily going to be the way forward. However, there is still a huge cohort of SMEs that have fairly good awareness of the opportunity, but they do not necessarily know how to take that step to adopt.

When we did the underpinning work for the Made Smarter Review, what we saw was that, from the businesses we surveyed, the two top factors that were barriers to adoption, as identified by the companies themselves, were concerns about cybersecurity and the sense that they lacked the technical skills to know where to start.

Q68 Mark Pawsey: Do you get any sense of the concern that I have heard about, which is that businesses do not think that the technology is adaptable, and that if they buy automation for one process and then perhaps the business for that process declines, they are not going to be able to modify that? How can they be made aware of that message of increased adaptability?

Dr Sillem: The stronger point that came out, for us, was about people just struggling to understand how these exciting-sounding technologies could be translated in a practical way into their own businesses, at an acceptable cost and with a reasonable return on investment in the near term for them. Use cases, demonstrators and places where people can go to just see these technologies in action will really be helpful, and that is very much what you have heard about under the Made Smarter initiative and that is what the Catapults are busy doing. That would be my view.

Q69 Mark Pawsey: Nico, we spoke about dirty and dangerous, but you have had some funding from Government for working in extreme environments. What examples are there of those?

Professor Avdelidis: We currently have a project on this, which started just last Friday. It is again creating an automated robotic system that is equipped with different kinds of sensors and facilities, like ultrasound for cleaning of the biofouling on the monopile. This is something that, for sure, you do not want to use a human operator for, so the robotic automated system could solve such a problem.

Q70 Drew Hendry: Jeremy, what sort of new businesses are joining the Manufacturing Technology Centre and how are you attracting them?



Jeremy Hadall: We are seeing new businesses joining from the construction sector and from what I guess you would call the fast-moving consumer goods, but I would include food and drink in those sectors. Why are they coming to us? They are coming to us because they see us as a place to understand about new technology, so the meeting point that was mentioned earlier—the meeting of minds and meeting some of the very clever but also very practical engineers we have on site—and being able to see the technology in reality and, to some extent, play with it. We often refer to it as one of the biggest manufacturing sites that does not make anything, and that is exactly the case. We do not make anything; it is a place where you can break a manufacturing technology before you break it in your factory. It takes that risk away and that really attracts people.

- Q71 **Drew Hendry:** You have described the kind of support businesses are looking for—information on automation—via the MTC, but do you feel you are equipped to deliver the right level of support?

Jeremy Hadall: I am always going to say I would like more.

- Q72 **Drew Hendry:** What more would you like?

Jeremy Hadall: I would like more people. If I was able to recruit more engineers, I would be able to work with more companies. I feel we have the right breadth of equipment and, again, I am never going to say no to more equipment. I have been working in robotics for 20 years, so I love robots and I would love more robots in our facilities.

The biggest thing, for us, is the ability to go out and help people. That is about more people, but it is also about the funding support. For a small company, it is difficult to come and talk to us, because it involves a financial outlay and it involves them giving up the time from their normal day-to-day job. We often hear the comment that an SME would love to come and talk to us, but the choice is to spend half a day driving to Coventry and talking to us or half a day making sure that their order goes out the door and keeping their client happy. As an SME, you can understand where they are going to spend their time, so being able to provide that support to somebody is something that we really need to build on, and we do build on it.

- Q73 **Drew Hendry:** You feel you are off to a good start, but there is a real deficit in terms of being able to provide the support you could because of a lack of staff and funding; is that fair to say?

Jeremy Hadall: That is fair to say.

- Q74 **Drew Hendry:** Before I move to the others on the panel, I have one final question directly to you. Is there potential for an automation or robotics catalyst or should the focus be on sectors such as manufacturing, in your view?



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Jeremy Hadall: There is a need for leadership. We talked about this earlier. There is a need for leadership across the robotics and automation sector. It is quite fragmented. We have seen that with some of the recent work that has been done with the robotics sector deal. There is a need for that fragmentation to be addressed, because manufacturing industry robotics have been around since the 1950s, for many years. There is lots that we know that we can help other sectors in robotics with, but there is lots that we can learn from other sectors. We tend to be quite conservative in what we do with our robotics, but some of the things that perhaps Nico and other companies do we can learn a lot from. In terms of a catalyst, a physical thing, perhaps not, but in terms of leadership, collaboration and a way of working together, yes, definitely.

Q75 **Drew Hendry:** On that same question—a focus on manufacturing or a Catapult—what would you say?

Dr Sillem: You have heard now from two sets of witnesses—and, I am sure, others as well—about this challenge of fragmentation and perhaps a little bit of a history in the UK of spreading the jam just a touch too thinly. There are certain initiatives that are already up and running and making those really work at the scale and level of impact that they have the potential to is the first priority. Whether that means reinforcing Made Smarter as a sector deal, whether that means ensuring that the High Value Manufacturing Catapult is adequately funded, trying to make sure that the initiatives that have already taken hold and are starting to bear fruit really flourish would be my top priority.

I do think the Catapults have an incredibly important role to play and there are many sectors beyond manufacturing, as narrowly cast, which will be impacted by digitisation.

Q76 **Drew Hendry:** Following that through logically, what difference would that make?

Dr Sillem: We have many strengths in the UK. We are often focused on things that are not as successful as we would like them to be, but we do have very high-quality skills; we have an extraordinary research base; we have some fantastic, innovative companies across a range of sectors; we have historic strengths in manufacturing. Making sure that we harness those and build on them at this crucial time point for the UK is a huge opportunity and if we fail to do it, we will look back with regret.

Q77 **Drew Hendry:** In your view, could a Catapult do that?

Dr Sillem: Catapults are part of it. When we ask industry about how the UK looks from the perspective of a place to put their high value investments, one of the messages we get back repeatedly is that stability would be greatly valued in the UK system to a greater extent than it is currently found. The Catapults are still relatively young organisations; allowing them to mature and building out from there is something that would be valued and valuable.



Professor Avdelidis: I totally agree about the Catapults. The Catapults are very strongly orientated establishments that can help especially SMEs, but also the networking with large organisations or even universities can help an SME to grow even bigger into the market for products.

Q78 **Antoinette Sandbach:** Later on in the inquiry, we are going to be hearing from some academics working on automation, but how much are businesses and higher education facilities collaborating? Nico, you show an example of that where your spinout company has come out of a university, but how much collaboration is there?

Professor Avdelidis: From my point of view, it is quite a lot, especially through the Innovate UK calls. The Government have been very helpful on this for many years now, and for all the calls that are out for research you usually have research organisations or academic establishments working together with small or even medium-sized SMEs, to help to make a product development for the market.

Q79 **Antoinette Sandbach:** Have you found that that is the same, Dr Sillem?

Dr Sillem: Yes. The UK ranks sixth in the world for business-university collaboration. The academy supported the Dowling Review of Business-University Research Collaboration back in 2015, and we would say we have seen an improving picture since then. There are many excellent examples of successful collaborations between our academics and companies both large and small, but we always know that there is more to do, particularly attracting SMEs and less transactional relationships and more long-term co-investment in shared research agendas.

Q80 **Antoinette Sandbach:** Why is that not happening?

Dr Sillem: There were various factors that were diagnosed through the Dowling Review, one of which was the sheer complexity of navigating the UK support system. For an SME looking for potential support or even looking for a university partner, it is a very complicated landscape that they are confronted with and so our recommendation was to hide the wiring. The creation of UK Research and Innovation provides a good opportunity to learn from what Innovate UK was already doing well and spread that good practice across the whole of UKRI.

That is very much a work in progress, and I suspect also that the pressures on universities mean that you have to have the trade-off between the short-term income that you generate through more transactional contract-type relationships with companies and the longer term co-creation of a research project. That is a more expensive thing to do unless you have access to grant funding to support that.

Q81 **Antoinette Sandbach:** Do you agree with that, Jeremy?



Jeremy Hadall: I do. One of the other challenges that the academic side of that equation has to deal with is the way that the funding mechanisms are set up for them. In our experience, there is a desire from a lot of the senior academics to chase papers and innovation and not necessarily business collaboration, because—although this is changing—the way that REF is structured is more about papers and innovation and less about business collaboration.

On the level of collaboration, there are two elements. We see a lot of start-ups and spinouts coming out of university laboratories. At the other end of the spectrum, we see very large companies, such as Rolls-Royce, working with a number of universities to develop university technical centres. The bit that is missing is the bit in the middle. If you are not a start-up or spinout that has come out of a university lab and you are not Rolls-Royce or Jaguar Land Rover or Airbus or somebody of that size, what do you do? How do you engage with the academics? That is the challenge and, as we have said, more support for the SMEs to be able to engage with the academics, clearing up the wiring, as it has been put, is really important.

Dr Sillem: Working through supply chains can be a really good way of trying to close that gap.

Q82 **Antoinette Sandbach:** In terms of attracting researchers into the UK, specifically in the field of automation, how good are we at doing that and should we be doing more to attract expertise into the UK in areas where we may not necessarily have it here?

Jeremy Hadall: In our experience, it is very easy to attract researchers into the UK from overseas. It is less easy to attract researchers from the UK into that field.

Dr Sillem: We have great research strengths in a lot of the underpinning technologies that are the source of disruption, and we could probably do a better job of investing sufficiently in the closer-to-market research and the expertise that underpins scale-up. Those underpinning areas of research strength, whether it is in robotics or AI, are pretty good in the UK. You tend to see a really vibrant start-up community, as you have described, around those, but we have not invested as much in the later-stage demonstration and deployment of these technologies in real-world environments.

Q83 **Antoinette Sandbach:** How would you solve that? What would you do if you could wave a wand?

Dr Sillem: All of us, in our own ways, are contributing to that, and the Industrial Strategy Challenge Fund is obviously an important new intervention, from that perspective. We need to make sure that the money is going to that later-stage R&D, deployment and demonstration of technologies in real-world environments. There is probably a lot more that we could do to be creative about using existing infrastructure as



living labs. There are some great examples around Milton Keynes in autonomous vehicles, but also hospitals, disused airfields, nuclear power plants. These are all places where we can become expert at deploying these disruptive technologies in real-world environments and that will help with our positioning as a country that is at the forefront of the fourth industrial revolution rather than playing catch up. It enables us to be part of shaping the regulatory environment, building a technical skills base at all levels, etc.

Q84 Antoinette Sandbach: Do any of you see any impact from Brexit on your ability to attract people into the UK?

Professor Avdelidis: We will find out very soon. Possibly. It might affect things, especially when you want to hire people like engineers or researchers coming from a European country. It is not for me to say, of course, but hopefully the Government will predict this and will have something as a solution after the 29th.

Jeremy Hadall: At the moment it is unclear. We are in a fortunate position where a number of our engineers from overseas are not affected by this because they do not come from the EU, but a large proportion do. We have seen people leave due to uncertainty and return to their home country, but it is not in huge numbers. Are we struggling to recruit people or are we seeing a drop off in demand from EU citizens wanting to come and work for us? Not yet.

Dr Sillem: We do have an overall significant shortfall in engineering skills. EngineeringUK estimates it at 59,000 per year that we are short, level 3 and above. We reckon that there are hundreds of thousands of engineers who are non-UK EU nationals in the UK at the moment and so, as others have said, it is uncertain what the impact will be. No matter how much we try to redouble our effort to increase our domestic skill supply, we will continue to need to access great expertise from beyond the UK, so that would be our concern.

Q85 Peter Kyle: Dr Sillem, would you say that Government policy is broadly going in the right direction?

Dr Sillem: There are lots of very encouraging things, from the perspective of Industry 4.0 or industrial digitalisation, however you want to describe it. The fact that we have the Industrial Strategy Challenge Fund, Catapults, Made Smarter and an industrial strategy at all are all very positive things. Lots of them, as you have heard, are quite early in their gestation, so we do not want to start twiddling too many knobs at this point in time.

The area that I would really like to see more effort on is just making sure that we have a sense of urgency, that we have the right scale of ambition and investment, and that we tackle the need for greater co-ordination. We need to make sure that all these levers that we can pull on are delivering us the best outcomes.



Q86 **Peter Kyle:** Are there any regulatory barriers for AI or robotics?

Dr Sillem: I would refer back to my earlier comments around trying to make sure that we are at the forefront of shaping the regulation for these new and disruptive areas of technology. It is not so much that today there are regulatory hurdles, but there is going to have to be a lot of work to understand what the regulatory and wider ethical framework and the standards are that are going to apply to some of these disruptive technologies in real-world environments. Making sure that we are at the leading edge of implementing those technologies and thus very much engaged in shaping the regulation is very important.

Q87 **Peter Kyle:** If there is no regulatory problem right now and the sector has evolved hugely in the last five years, then something is going right.

Dr Sillem: I think lots of things are going right; I really do. We have many of the ingredients for success, but there are also threats. As I said earlier, competitiveness is such a key lens to view automation through. In terms of the narrative around "Are robots going to take away jobs? Is technology going to displace jobs?" it is not technology per se; it is our inability to maintain competitiveness, so the jobs go elsewhere.

Q88 **Peter Kyle:** Yes, but with regards to regulation and how regulation evolves over time, because some of these industries are disruptive and they emerge very rapidly into the market in a way that simply has not happened in the past, are you and your members being engaged by regulators quickly enough, and is the regulatory system evolving and capable of evolving fast enough for Britain to be a global pioneer in this sector?

Dr Sillem: It is a really important issue that we make sure we can address. Our system of regulation and standards is well populated by experts, who are highly regarded internationally. We need to make sure that continues to be the case. There is no need for complacency, but I have not seen barriers to date.

Q89 **Peter Kyle:** Jeremy, do you think that the challenge fund is the right vehicle for the time?

Jeremy Hadall: It probably is. For us, the key point is that it needs to be consistent and it needs to keep going. We need to give it time to bed in and grow. It is widely welcomed and we definitely need it and, as I say, let us keep going with it.

Q90 **Peter Kyle:** Anybody on the panel can answer this question. Is there enough investment coming from non-Government sources at the moment, as we, as an economy, equip ourselves for the future of automation and taking advantage of it? Who wants to leap forward?

Jeremy Hadall: In areas there is. One of the challenges we see—and it is around the spinout side of the market—is maintaining that investment. It is a little bit too easy for a venture capitalist to buy into a spinout



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company and then sell it on in five years' time to, potentially, another country or another nation. That is too prevalent at the moment.

Q91 **Peter Kyle:** Is there enough non-Governmental investment though?

Jeremy Hadall: It is difficult to say. I am not sure I can answer that.

Dr Sillem: The Treasury has been doing a lot of work on patient capital and it is particularly positive that it is now looking at trying to encourage pension funds to invest in growth capital as part of their portfolio. We do lose out sometimes compared to other economies, where there is not as much patient capital that is necessary for the long-term growth and growth to scale of companies in the UK in high-technology areas.

Q92 **Peter Kyle:** If we were to have a sector deal for robotics, what would it look like?

Dr Sillem: As you heard from the previous panel, there is already work being done to sketch a sector deal for robotics and it would cover things like innovation, skills and co-ordination. As Brian said to you—and I do not want to keep repeating myself—we should consolidate things like the Made Smarter initiative, which is still very early in its gestation. Already the work that has been done in the UK on robotics, creating the robotics SIG, has helped to bring a coherence to a community that was previously very disparate. There has already been good progress made and we need to maintain that momentum.

Q93 **Antoinette Sandbach:** I would like to go back to the issue regarding attracting a more diverse workforce. There used to be a brilliant scheme run by engineers, called Engineering Education UK. I do not know if that has morphed into something else, but it partnered engineering businesses with both primary and secondary schools. The Royal Academy was leading on that. Is that programme still running?

Dr Sillem: There is still an organisation called EngineeringUK and I suspect that is probably what you are referring to; I am not completely certain. EngineeringUK does hold the lead for co-ordination of the very many initiatives that exist to promote engineering—the “E” in “STEM”, if you like—to young people in the school system and outside of it.

The academy has been working very closely with EngineeringUK, over the past year, in particular, to try to improve this very fragmented picture that you have all heard about. We counted more than 600 organisations or groups of organisations active in trying to promote engineering to young people. You can imagine how difficult that is for schools to navigate and how ineffective it is. Our lack of progress on both the numbers and the diversity of those coming into engineering tells us that we simply have not been effective to date. The focus of the current work is on trying to bring the wider community—the businesses, the charities that are involved in promoting engineering to young people—together to work under a single umbrella, to develop a portal that will mean that schools have a one-stop shop to access the full suite of programmes on



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offer to support them. It is also about making sure that there is some quality control, so everybody agrees to meet a minimum threshold for best practice and to use a shared evaluation framework so that we can all convince ourselves that our investments are going to be more effective this time around than they have been in the past.

Q94 **Antoinette Sandbach:** Has that launched?

Dr Sillem: That is ongoing. It will be very familiar to people who work in the STEM promotion landscape within the engineering community and you will hear more about it in the next 12 months.

Q95 **Antoinette Sandbach:** I would love to get involved. I am sure many people on this Committee would love to be able to promote that to their schools, because I saw it work first-hand, and there seemed to be enormous numbers of girls and boys involved. At a young age, there does not seem to be any differentiation between the two groups in terms of approaching engineering as something practical and problem-solving.

Dr Sillem: If you will forgive me coming back, it is a subject I am very passionate about. I just wanted to say that one of the ways the Committee could help is also by recognising that endlessly talking about promoting science or STEM to young people is not meeting the specific challenge we have around engineering. There is no problem in terms of the number of girls and young women pursuing, for example, the biosciences. It is engineering, together with a bit of physics and computer science, that drags down the average for those going into STEM to about 50%. In 2019, we still have a profession that is 12% female in engineering. We have hardly shifted the numbers going into engineering apprenticeships: 7% women; 15% or 16% going into higher education degrees. This is unacceptable. The engineering profession is working hard to get its act together, but we also need other people to help us change the perceptions of engineering.

This is Engineering was mentioned in the last session. This is a campaign that, with EngineeringUK support and the support of industry partners, we are running to reposition engineering in the minds of young people. It is a great example of how social media and the power of digital marketing helps us reach the audiences. There have been 30 million views of those videos within the past 12 months by that target audience, gender balanced, and there is a lot we can learn about how we reach other groups in terms of industrial digitalisation. Trying to reach SMEs, for example, with the power of digital marketing you can reach large numbers of people in a highly targeted way for really quite modest amounts of money. That is something we should probably embrace more in the wider fourth industrial revolution agenda.

Q96 **Antoinette Sandbach:** Once you have reached those people, how easy is it to access the training to give them the skills that they then need to come into your field?



Dr Sillem: We have provision in higher education and further education that is good. As others have said, we need to make sure that it is in line with the current needs of industry, not just the historic needs, so up-skilling and re-skilling those who are delivering that training is really important. Also, looking at our post-16 curriculum to broaden it out would be immensely valuable. I also very much agree with the other panel regarding the importance of up-skilling and re-skilling, and if there is one thing that has not been gripped as firmly in the UK as it needs to be it is lifelong learning. It is very hard, because there is no clear owner within Government; it is very distributed and is of interest to many Departments. That is going to be absolutely crucial to our future competitiveness and we need to really up our game there.

Antoinette Sandbach: I saw you nodding there, Jeremy.

Jeremy Hadall: Yes, I agree with the lifelong learning. It is something that MTC has been looking at for a long time and we are very aware of this problem.

Just as an aside, MTC is perhaps unique. We have somewhere in the region of 30% women in our organisation, and our apprenticeship scheme has considerably more women than the previous panel discussed coming through, so we are feeling quite fortunate.

Q97 **Antoinette Sandbach:** Why is that?

Jeremy Hadall: I wish I could give you a very easy answer to that one. I do not know. We are very strong on our diversity; we treat it very importantly. This month is diversity month within MTC; it is a big focus for us. I think we just treat everyone as equals regardless of gender, race or whatever. Maybe that is one of the joys of the Catapult centres: because we are this meeting place we get this diversity. Indeed, MTC is not alone; if you take AMRC, AFRC and all of the Catapult centres, they are pretty much the same.

Antoinette Sandbach: Our experience, certainly, when we went up—

Jeremy Hadall: That was interesting.

Q98 **Anna Turley:** You had my questions earlier about the impact on the workforce of automation. How far ahead can businesses and Government predict the technologies that are going to affect the industry? It is a bit like crystal ball gazing, but is there more the Government could be doing to ensure businesses are prepared for the fourth industrial revolution?

Jeremy Hadall: This ties into the re-skilling point. It is about being able to have a modular education system, particularly at levels 4 and 5, which is completely missing at the moment. It is about being able to create those modules that allow people to adapt to the new technologies that are coming through, to be able to be trained, skilled in those new technologies but also be able to create those new modules as things come up. As you have heard, it is a very disruptive industry. I would



like to think that we are at the forefront of it at times, but we get caught out occasionally, because things will just crop up. People will come up with ideas and we will go, "Wow, that is amazing. Now how do we deal with that?" We have to have that responsiveness in our education system to be able to train the future workforce.

Q99 Anna Turley: In terms of the workforce today, how concerned should people be about the implications for their jobs in the long run?

Dr Sillem: If we can get our lifelong learning up and running at the level it needs to be and better connect those people who have expertise, for example, in the MTCs or in the academic research base, with those who are trying to deliver training to people, we have a very good chance of minimising the negative impact on jobs and seeing lots of new sorts of roles being created. I am an optimist in that respect. I am not belittling the fact that people's jobs will change, but I do not think that we are helpless in the situation.

The fact that we cannot predict with certainty what the future holds should not stop us doing things that we know are sensible now, like broadening out our curriculum in schools, post 16, and making sure that we have a much more agile and responsive feedback loop between those who understand where technologies are going and those who need training. Unless we do proactively think about which groups we need to help to participate in future economic activity, there is a risk it will reinforce inequality and bias in our current workforce. If we are smart and proactive about it, we can do a lot.

Professor Avdelidis: I totally agree with the panel. I just wanted to add that starting from a young age, from the schools and everything, if we start to promote not just engineering but any kind of technologies, it will help to have a better balance between female and male engineers or technologists in the end. I was reading some statistics on physics and, usually, female students get higher marks than their male counterparts, which shows that they have the ability to go further. If we, as companies or even as universities, try to promote this through the schools and everything, it might help to build it up.

Chair: Thank you very much. Thank you, all three of you, for coming to give evidence this morning. It has been incredibly interesting and fascinating for all of us, so thank you for your time today.