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The Select Committee on Digital Skills

Inquiry on

DIGITAL SKILLS

Evidence Session No. 4 *Heard in Public* *Questions 40 - 52*

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11.20 am

Witnesses: Hugh Milward, Chris Mairs CBE and Mike Warriner

USE OF THE TRANSCRIPT

This is a corrected transcript of evidence taken in public and webcast on www.parliamentlive.tv.

Members present

Baroness Morgan of Huyton (Chairman)
Lord Aberdare
Earl of Courtown
Baroness Garden of Frognal
Lord Giddens
Lord Haskel
Lord Janvrin
Lord Kirkwood of Kirkhope
Lord Lucas
Lord Macdonald of Tradeston
Baroness O'Cathain

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Examination of Witnesses

Hugh Milward, Director of Corporate Affairs, Microsoft, **Chris Mairs** CBE, Chair, UK Forum for Computing Education and Chief Scientist, Metaswitch Networks, and **Mike Warriner**, UK Director of Engineering, Google

The Chairman: Thank you very much for joining us this morning. You may have heard this preamble before the last session but I need to do it again in case somebody did not hear it. You have a list of interests that have been declared by Committee members. These were declared orally by members at the previous session on Tuesday 8 July, and can be found in the transcript. This is a formal evidence-taking session of the Committee and a full note will be taken, which will be put on the public record in printed form and on the parliamentary website. You will be sent a copy of the transcript and you will be able to revise any minor errors. This session is on the record. It is being webcast live and will be subsequently accessible via the parliamentary website. You are very welcome to submit supplementary evidence after the session. In fact we would very much welcome that. Just to remind everybody here, we should speak up so that everybody can hear properly, although I think the acoustics are quite good in this room. I will come to you in turn just to introduce yourselves, and if you want to make any brief, opening remarks, that is fine. Otherwise we will go straight into the questions. Mr Mairs.

Chris Mairs: I am Chris Mairs. I am Chief Scientist at Metaswitch Networks and I am also Chair of the UK Forum for Computer Education, which is focused on practice and policy challenges around the new computing curriculum.

Mike Warriner: I am Mike Warriner. I am Engineering Director at Google here in the UK where we have about 700 engineers building products like YouTube, Android, advertising products and other things. Just for clarity, we also have an interest in the Google campus here in the UK, which is a start-up hub in Tech City that we run.

Hugh Milward: My name is Hugh Milward. I am the Corporate Affairs Director at Microsoft here in the UK. As well as Microsoft we also have Microsoft Research, our research facility based in Cambridge. We also have Skype, which is part of Microsoft too, Xbox, and an interest in Microsoft Ventures, which is our accelerator based in Tech City as well.

Q40 The Chairman: Thank you very much indeed. We will start with a wide-ranging open question. Can you try to sketch for this Committee the pace and change of the future digital technology landscape over the next five, 10, 15 years, and try to describe for us in the broadest terms the impact that is going to have on the UK, both socially and economically? Shall I start with you, Mr Milward?

Hugh Milward: It is very difficult to predict in this sector. I think we are all agreed on that. But we see there being perhaps three trends. At least, that is the way that Microsoft looks at the world. Three trends at the moment, which we think will help to define the way the technology is developing. The first is more natural, and we look at this as being able to move freely across different devices and different areas. We expect these devices to co-exist and to share information, to have intuitive and consistent designs and to interact in similar ways in which we interact with people, using speech and gesture as well as touch and type and making devices much more accessible.

The second trend is more contextualised. With our permission services will link our data to friends and to the wider world around us, making our experience richer and more relevant to the context that we are currently in. With technology such as 3D printing, we will be able to print objects to our own specifications, pointing to a future where we can tailor the physical environment around us as much as our virtual world.

The third is that technologies will work harder on our behalf and that means machine learning, enabling computers to process data and predict or anticipate needs so that, for example, your car will reroute your journey to avoid traffic, your thermostat will adjust automatically depending on the weather, or your supermarket order will be prepopulated based on your calendar for the next week or next two weeks.

The Chairman: Will it do the ironing? That is what I always ask in these situations. I am always told that it can do all these things, but that would be the final test for me.

Mike Warriner: I can only say that I wish the answer to that last question was yes. There is a whole tonne of technology trends. The one that is very clear is mobile technology. On a global scale at the moment something like 2.5 billion people are internet-connected, and over the next five or six years that is predicted to go to 5 billion people. You imagine what that does; it is an opportunity for people across the world to get connected and to start having the same access to information and services that we take for granted here. If you invert that, it gives us the opportunity, as a highly advanced nation, to be able to sell services information, and what have you, back to those new people on the internet. I think that is an exciting trend.

Another trend I would highlight is Cloud and Cloud computing. I highlight that mainly because it has reduced the barrier to entry for people to set up a business and to get online. Historically you would have to buy yourself a data centre. Now you can take your credit card and have a business online that has a global scale—a global internet business. That is a profound change and has enabled a whole bunch of small start-ups to get global scale very quickly, and is something that we should take into account.

Another trend, which I think is the same as Hugh's, is the idea of the internet of things: that as things become more and more connected as we can make computers that are small enough to put into a thermostat or a fridge, and we can start to think about a much more intelligent way of living our lives. The classic example would be looking at your thermostat

and controlling the heating in your house. In a football match's break at halftime, the people watching that football match would historically always run to their kitchen to put the kettle on and you would see these spikes in electricity usage. Now the electricity company—they are already doing this in America—can turn off heating systems for that few minutes so that they can manage their electricity more intelligently and provide a better service to us all. I think that is exciting.

Chris Mairs: I am going to start off with a general comment, which is almost a statement of religious belief rather than anything that is hard evidence-based. There is a guy called Hofstadter who has a very interesting principle relating to projects in technology: that every project in technology will take longer than you thought it would, even after taking Hofstadter's principle into account. I am going to apply a similar principle to the pace of technological change, which is that I believe that technology will change society at a faster pace than we believe it will, even after taking this principle into account. I think that is important because things like Moore's law mean that things are going to change so fast that we cannot yet know what will happen.

I agree with everything that Hugh and Mike said about significant technologies. I am going to use a couple of examples to illustrate what I think are some of the potentially very significant social changes that will happen. One of the companies I work with at the moment provides a service, which is not complex, as a digital service. They put people who want their houses cleaned in London in touch with people who clean houses. It is not quite like technology doing the ironing but it is the next best thing.

The Chairman: It gets it done, yes.

Chris Mairs: This is interesting because this is a digital market place and it allows individual cleaners to acquire customers and manage their reputation in a way that has not previously been possible. That changes the whole cost dynamics, so as this product grows and becomes more successful you will see individuals—micro-SMEs, if you like—being able to compete effectively against cleaning agencies, for example. It shifts the balance of power down to micro-SMEs.

Another example, which I think is quite interesting, is that the reinsurance industry is incredibly arcane. It is a trillion-dollar business and right now it is run primarily using paper, so it is ripe for disruption. It will probably get disrupted by somebody who understands the reinsurance business and has probably been a reinsurance broker but also happens to have a PhD in big data science and has good business skills. What I think is going to be very important over the coming years is a combination of technology skills and skills in other businesses, because it is that ability to understand how technology can apply to a particular industry that will allow you to be a disruptive player.

There is one further technology that I do not think the other two guys mentioned, which is potentially a massive game changer. I do not know if that is true or not, but it is cryptocurrency. Some people believe that cryptocurrencies such as BitCoin can fundamentally change the banking sector, and if that happens it will again have a significant impact on society.

Q41 Lord Haskel: Thank you for that. They seem like very exciting opportunities, but how well are we prepared for this change in technological landscape? What does the general

population understand about this, and how are we going to adapt to these changing technology trends?

Chris Mairs: Unsurprisingly I think it varies hugely depending on which segment of the population you look at. In general, young people are better able to envisage the changes than older people, and people who are in the technology sector are obviously at an advantage. The biggest challenge is particularly in smaller businesses. If you take a FTSE 100 company, as the chief executive you can surround yourself with people who understand the technology, understand the opportunities. If you are an SME, you are probably not so able to do that and so, as a country, we need to think about how to empower SMEs to take advantage of this.

This comes back to the question of lifelong learning, and we have historically always viewed apprenticeships as something that you do until your early or mid-20s. Maybe we should be thinking about later life apprenticeships as one way to address this.

Mike Warriner: On one hand we are very well prepared and on another hand we are very ill prepared. In terms of us as an economy, our e-commerce economy is predicted to be £140 billion by 2016. The internet exports from the UK are over $1 billion. We are significantly ahead of our nearest competitors in Europe on the internet and in e-commerce electronic-related exports. That in itself is a huge testimony to how successful we have been.

On the other hand we still have 7 million people in this country who have never used the internet—a truly terrifying statistic. That means that something like 15 million people over the age of 15 are not internet literate, if you like—another terrifying statistic. The idea of things like later life apprenticeships is fundamental. There is an opportunity for us to invest in things like Code Club and Teach First, where we help the teachers—both of school children and adults—to teach these subjects, to get people inspired, to get people aware and to help people themselves to learn how they should learn. That is the only way we are going to scale that and make that work.

Hugh Milward: I have perhaps one more thing to add to that. It depends on whether we are talking about the end user or the sort of intermediary that is going to leverage a new technology for the benefit of the end user. If we get this right as technology companies, we should be able to create or do a lot better in making the designs much more intuitive to the end user.

When you look at the developments that all our companies are pushing, you effectively do not use manuals any more; you expect to have an intuitive understanding of the way technology works. The end user is one thing, and perhaps the level of training required to take advantage of these trends is less than you might expect. That is not the case for the intermediary, perhaps a business that needs to take advantage of one of these trends in order to offer a service or to deliver more to the end user than they currently are able to do. I think that is a risk and an area that needs focus.

To pick up on Chris's, point, we certainly see there being a need for developers, for example. We have various tools, which I can go into, which help us to look at the future needs. There is definitely a need for developers among the start-up community, but that is not enough; they also need to be developers with HR skills, marketing skills, finance and various other aspects as well. But unless we are building those fundamentals in at the beginning, I do not

think we are going to be as effective as we could be in increasing the skillset at that intermediary level.

Q42 Lord Haskel: What should we be advising the Government to do to prepare the country to take advantage of all this?

Hugh Milward: I will continue on that, if I may. One of the great changes recently, and it is a long-term play rather than an immediate play, is the removal of the requirement to teach ICT in schools, replaced by the option to teach or the requirement to teach computer science. Bear in mind that computer science is not the same as coding, and it is very important that we do not confuse or conflate the two; they are very different. Teaching computational thinking, which is effectively what it is, will with any luck have a profound effect on that, so we need to increase the mix of the ability of companies to take advantage of the technologies while continuing to focus on other things that are not technology-focused.

I cite not quite as evidence but nearly as evidence of this the initial work that we have been doing with schools in teaching computer science, which has shown that kids do much better in all other subjects as a result of learning computer science, particularly literacy. So it has this profound effect.

The Chairman: Yes, it is a brain enhancer.

Hugh Milward: That is right. The UK is very progressive in this area, which gives us a good, strong, competitive advantage or opportunity for the future as we go on, so I offer that as an answer.

The Chairman: Lady O'Cathain, you wanted to come in with a supplementary and then Lord Lucas.

Baroness O'Cathain: Just quickly, is there any way we can get another country to look at that? I am just wondering particularly about Microsoft and Google. I went to a presentation in Brussels, on unemployment as it happens, but there was a presentation from Singapore about how they manage to get their schools literally computer literate from the time they are financially literate. Is there any way we could exchange best practice? We have a good history of learning in this country, with the universities and so on, and we have sent it all over the world. Can we go around the world and see who has cracked this one while we have still been doing Shakespeare?

Chris Mairs: One country that I would recommend you look at is Estonia.

The Chairman: Yes, we have heard that. That has been raised.

Chris Mairs: Very interestingly, they have an extremely strong technical university, and one of their strengths is that quite a few of their politicians came up through a technical background. That is pretty significant.

The Chairman: That is interesting.

Baroness O'Cathain: The same may not be said here.

The Chairman: Lord Lucas, you wanted to come in.

Lord Lucas: Chris and Mike, you both mentioned later-life apprenticeships. Are you aware of any tech companies that are pushing the availability of such things and looking actively for

women who are coming back after raising children and wanting a new career? If not, could the Government be doing something to encourage you?

Mike Warriner: We ourselves in some of our offices are already running programmes. In Israel, for example, we have a programme, whose name has completely escaped me, to encourage people who are coming back from maternity leave to come back and be prepared for the fact that they have taken a year out of industry, and to help them get back into their jobs.

Lord Lucas: But into tech jobs? I assume you are talking about HR or something like that.

Mike Warriner: No, it is absolutely to do with anything that Google does. We do everything from engineering to HR, but this is very much an engineering focus. We have very publicly released our diversity numbers: 30% of Google is female. That is shocking. It is not far off the industry average in our industry but it is still pretty bad. Seventeen per cent of our engineers are female, which is even worse. We are drawing on a pool where something like 15 times as many people doing computer science A-level are boys compared with women, so we need to fix this right from the beginning of the curriculum.

Lord Lucas: But you ought to be taking women who have never done IT and training them as if they were new apprentices. They need new careers. They never learnt about IT when they were at school because it was not offered.

Mike Warriner: That is done through things like Code Club and Decoded, and a lot of those organisations. We are not teachers, so from our point of view we can help fund the organisations that do know how to teach people, and they then can help provide this teaching to people out there across the whole country. Decoded do a great job, Code Club do a great job, as does Code Club Pro teaching teachers. There are a lot of these initiatives.

The Chairman: Without putting words into your mouth it sounds to me as though you are saying that if there is a clearer framework from the Government on this, employers might be prepared to do this. You have talked about the return from maternity leave, but you have not told us that you are taking in older workers and doing what you just said was needed, which is providing older apprenticeships. We are not particularly picking on you. You are here in front of us, so it is good to ask you what is needed to make that happen. Mr Mairs?

Chris Mairs: Mike at Google has a particular challenge in that Google is at the very hard end of technology, and I think we should not focus too heavily on people coming back who have not done any IT at all and then suddenly becoming big data scientists. There are many, many other jobs in the economy where good digital skills will augment other skills. Being able to use technology in a reasonably sophisticated way is beneficial to someone who is working in HR, in finance, whatever. I do think that through government policy or funding we could encourage more of those sorts of mixed apprenticeships along those lines.

Q43 Lord Macdonald of Tradeston: A point for Microsoft. You spoke very encouragingly of the route that would make everything simpler and more intuitive, but did your move from Windows 7 to Windows 8 not plunge millions into confusion? I do not just make a cheap point; I am asking how we can believe that it is going to get simpler when you have obviously made it much more difficult.

Hugh Milward: That is a lovely point. The parliamentary estate has recently moved to Office 365 and I am aware that there have been some bedding-in problems around that.

The Chairman: We are a digitally challenged group.

Hugh Milward: We can go into some specifics around that if you like, but I am not sure if the Committee is the right place to do it.

The Chairman: No.

Hugh Milward: The move from Windows 7 to Windows 8 effectively spearheaded a change in the way computers/PCs were built in that it ramped up the use of touch for your primary device. So in effect you are not using your browsing device but your primary functioning device to touch in a way that I would not call revolutionary because it is all part of an evolution—it forced Intel in particular to rethink its growth strategy for touch devices and to re-predict how the market was going to change quite fundamentally.

Yes, it has had a mixed reception, particularly because you are trying to have two different ways of communicating with the device at the same time built into the same device, which is never easy. As Windows 8 evolves and those two worlds—the old world of the mouse and the desktop—merge with the new world of touch and a kind of seamless transference, things will improve dramatically. I should also point to the fact that there are significant changes going on at Microsoft at the moment with a new chief executive who comes from an engineering background rather than a sales background, which I think will make significant adjustments to the way the business operates and sees its role and the role of the individual at the heart of what we do, which has not necessarily been the case in the past.

Q44 Lord Haskel: Coming back to what the Government can do, in other evidence we learnt that there are something like 75,000 young people studying hair and beauty. Yet that industry will be able to absorb, shall we say, 15,000 or 20,000 of them. Is there any way in which government could then say, "Okay, for the rest we will run a conversion course and try to convert the rest of the people who do not get into that industry in digital skills so that they can work elsewhere"? Rather than start with education and nine and 10 year-old children, we have a whole lot of 19 and 20 year-olds. What are we going to do with them? Can we run a conversion course or something like that?

The Chairman: Who wants to kick off on that?

Mike Warriner: I will give it a go. I think we have problems from age five to probably 95. It is never too late to start. I cite the example of my grandfather who at the age of 85 bought himself a computer and wrote two books. It is never too late to start. We need to be encouraging people at the age of five to see technology as something that they can aspire to and love doing. One of the previous members here was talking about it being a part of art, a part of your normal life. I think that is very, very important.

We need to be giving great careers advice at the age of 15, so that people study subjects that do not take them into dead-end careers. There are hundreds of thousands of jobs coming online now in the digital industry. There are hundreds of thousands of vacancies, but people do not have the skills to fill those jobs, so people from careers advice should not be putting them in this crazy place.

In terms of age groups, we should absolutely be looking at people coming out of schools, at 18 to 25 year-olds, and saying, "Yes, you have been given bad advice but here we can help you". I do not have the solution for how we should do this, but we should try to work with

industry and with government to solve that problem and to help to provide training so that they can come back into the skills that we do need.

The Chairman: Thank you. Mr Mairs, you want to come in now, and then I will go to Lady Garden.

Chris Mairs: I absolutely agree with Mike that there is a huge issue about career signposting in schools at the moment, and industry can do a lot to help that. I think government can do something to ensure that schools work more closely with industry to provide that signposting.

This brings us on to an interesting question about the gap for people who are starting on the new computing curriculum now—five year-olds. If that goes well it is a fantastic way of giving them the right skillset, but they are not going to come through until 2020. So between now and 2020 we have a digital economy that is moving on, but we are not going to get the benefit of this new curriculum, so should we be thinking about doing more to provide, for example, computer science modules for non-computer scientists at university as a way of upskilling some of the people who are currently doing subjects that are not necessarily so relevant?

The Chairman: That is very interesting. That sort of refresher or concentrated little course or whatever has come up from a variety of witnesses now. It is quite interesting. Lady Garden.

Q45 Baroness Garden of Frognal: You have touched on this already, but I wonder whether you have anything to add on the current high level skills shortages, and the skills needed to be developed to meet the demand for producers of digital technologies. Perhaps could I ask Mr Milward specifically. How do you create synergies between Microsoft and your Accelerator, and are different skills required for that?

Hugh Milward: Good question. We work with the IT Job Board to analyse the job postings in the IT sector and look at various aspects of what kind of IT jobs are available over a period of time, and that allows us to predict a bit to see on trend where things have been going and where they might continue to go. It reveals some very interesting aspects of skills requirements within different sectors. There is a transference across between the start-up and accelerator community and the much more established businesses. All of them are looking for developer skills—there is no doubt about that. Certainly, from our experience from Microsoft Ventures, start-ups are looking almost as an equity start-up partner. They are looking for developers but with a bit more HR, marketing and everything else. They are looking for developers at that apex. Having a set of skills that they have learnt through the education system that allows them to think more entrepreneurially and combine that with developer skills is something that every company wants. In our company—I am sure Google is the same—we are trying to push the boundaries of innovation within our own businesses, and the mindset that encourages and develops innovation is the same mindset in a start-up of two people. Those skillsets are the skills that we are chasing as much as the start-up community is chasing. If we intervene to try to improve the level of those skills—a kind of "rising tide floats all boats" sort of approach—it has an impact on everyone.

Baroness O'Cathain: Is it called the IT Job Board? Is that the website?

Hugh Milward: Yes. It is called IT Job Board.

Baroness O'Cathain: Do you advertise that? Have you sent that round to every school in the country as part of a careers advice type of thing?

The Chairman: That is not run by you, is it?

Hugh Milward: It is not run by us, no.

Baroness O'Cathain: I see. Who runs it?

Hugh Milward: It is a separate business and they advertise IT job vacancies in any sector. We work with them to look at the data that they have and the nature of the advertisements. It allows us to look at trends within different sectors: the finance sector, the law sector, marketing and so on. It allows us to look at the IT qualifications or IT demand within different sectors.

Baroness O'Cathain: You can let us have the link to that, can you?

Hugh Milward: I can, yes.

Baroness O'Cathain: Right, because we did the youth unemployment report recently and that was the major thing that came out: that there are nearly twice as many jobs available than there are skilled people to take them into the digital area. Careers advice has been hammered because they say it is no good, but if every school could have that, or if it was more generally known, I am sure it would be a great aid into education.

The Chairman: We will delve into that.

Baroness O'Cathain: Yes, I think we should follow that one up.

Hugh Milward: To go further than that, I think there is a definite opportunity for better advice and guidance at school level about the IT skills that are required in every sector, not just the IT sector.

Baroness O'Cathain: That would be great.

The Chairman: Yes, I think that is absolutely right. Mr Mairs?

Chris Mairs: There is also a public awareness issue here. It is not just the kids themselves getting the advice, it is the parents believing that this is a good career. I think the BBC could have a huge role to play in this. You will know that they are doing their push into this whole area in 2015, and making sure that parents realise that this is a great career and is just as good as becoming a doctor or a lawyer will help.

The Chairman: Yes, indeed. Let us move on. Lord Aberdare.

Q46 Lord Aberdare: Staying on the skills area, one of the things we have been looking at is whether there are different needs for the producers: digital producers versus the consumers. I think we have covered that a little. One of you introduced a new category of intermediaries, so perhaps there is a third category there. Perhaps going beyond what the actual shortage areas are, are there new ways of learning these skills that we need to think about? My five year-old granddaughter is certainly entirely familiar with an iPad. Are there ways of building on more informal learning methods, rather than just relying on courses in schools to deliver some of these needs?

Mike Warriner: Absolutely yes is the short answer. If you look at the way my nine year-old and seven year-old learn how to play Minecraft—apologies, you have probably heard

Minecraft mentioned—they watch YouTube in order to learn how to play Minecraft, and they are watching other people play Minecraft. They are learning incredibly sophisticated things by watching videos. That is a whole new kind of genre of learning that we should embrace and look at and say, "How can we use YouTube in schools?". First, how can we make sure that schools have the ability to have YouTube in schools, because it is blocked in an awful lot of schools or they do not have the infrastructure for it.

Secondly, how can we make sure that they are aware of the great content that is on services like YouTube but also across Coursera, the Khan Academy and the multitude of other online learning environments, and help teachers. There is a pivot, almost, in classes to help teachers think about perhaps getting schoolchildren to go home, watch the videos at home and then to use the classroom as a place to discuss those videos and talk about what they have learnt from them, rather than the teacher teaching them the material and hoping that they will somehow discuss it elsewhere.

Chris Mairs: I think this gets to the real heart of the single biggest challenge that we face here, which is that we have a new curriculum that I personally believe is going to be really, really important. However, we probably have about 200,000 primary school teachers who are being asked to teach this, and this is a huge, huge ask. Although we are doing some good stuff with CPD, which is being funded by government, I do not believe we are doing enough. But I also do not believe that even if we threw £100 million at future CPD we would get there. So we have to think about how to use technology to teach technology. As Mike said, the kids with peer learning will make progress faster than teachers, so we need to find a way to make the teachers comfortable with that method of learning, which is a bit scary if you are a teacher. There are potential opportunities to think about, such as having a new breed of learning technologists who go into classrooms and work alongside the teachers. It will not necessarily be cheap, but I think that is something we should look at as a serious way of empowering the teachers.

The Chairman: That is really helpful, because one of the things we try to do is say to everybody, "Give us a recommendation". That is a very helpful specific recommendation. You can see technologists coming more and more in the health service to widen the medical range, but in education we have not done that. Mr Milward?

Hugh Milward: It does not necessarily need to be government that makes that happen. We have thousands of employees within the business who want to make a contribution in their local communities and do the things that they know how to do and do it in schools.

The Chairman: Do the Government not need to help make that happen? Does there not need to be a little bit of organisation for this to happen, because otherwise, why is it not happening now?

Hugh Milward: I think there is a slight corporate fear of treading too hard on schools or getting too involved in schools. Certainly from Microsoft's perspective we have perhaps been on a path that is not necessarily the right path with ICT. The last thing we want to do with computer science is turn it again into a system that teaches kids how to use Microsoft products. That is absolutely not what we want. But it makes us a bit nervous when we go into schools that the legacy of that will somehow undermine what we are trying to do here, so if government can do that that would be helpful. There may be other players who are more important in helping to do that, including the teaching unions, for example.

The Chairman: Thank you. Lord Lucas, do you want to come in, because in a sense you follow on from this, do you not?

Q47 Lord Lucas: You have answered the next question. I would only ask Chris Mairs whether the projects that the Engineering Development Trust runs, getting industry to run real live projects in schools, might be a way of educating both teachers and kids.

Chris Mairs: The short answer is yes. I think that getting industry to come into schools is fantastically powerful not just for educating the kids but enthusing the kids. If you get the right sort of projects, like BLOODHOUND for example, that is a fantastic way to get kids to go, "Yes, this is exciting".

We have to be a little careful that it is not just about subject knowledge. There is also pedagogy associated with this, and we have to be careful to make sure that we do not assume that just bringing in someone who knows about the subject can then deliver that knowledge to the kids. It does need a combination of the two.

Mike Warriner: Can I just echo a point on that?

The Chairman: Yes, certainly.

Mike Warriner: It is important that government does not see industry as a wonderful bunch of teachers. I would make a terrible teacher, but what I can do is to help to advise people who do know how to teach what we should be teaching and how they could be teaching, but in no way do you want me, or probably most of my team, sat in front of a class of schoolchildren.

The Chairman: Yes. Understood.

Q48 Lord Macdonald of Tradeston: I want to ask you about how we might prepare individuals, businesses and so on for the digital shock that is going to happen to labour markets and to occupations. Of course we are reporting to Parliament in the hope of political action, and one of the concerns has to be that there would be a lot of social unrest related to this. Half a dozen times in my own working lifetime I can think of when that social unrest turned into disruption and serious violence. Are there ways in which your big data analytics can start to warn us where these misgivings are starting to become dangerous and will arise? Are there ways in which you can help predict in advance where the more sensitive areas might be, so that you could advise politicians on how best they could do it? Because with your social media you are probably adding to the volatility of many sections of society, were it ever to develop into unrest. Do you have a role for yourself in trying to help make sure that there is a smooth transition?

The Chairman: Who wants to try that one?

Hugh Milward: I think there is a responsibility among technology companies for helping society to navigate through the results of the innovation that they are driving. If you look at what Shaftesbury did for the Luddites, perhaps there is a parallel here with technology companies. In some respects what we do with technology has evolved rather than revolutionised, I think, so there is a shift in the job market rather than the collapse of one and the rise of another. As many opportunities arise out of technology development as sectors that decline. I do not know whether that answers your question.

But as to whether or not the big data can be used to predict and help navigate a way through this, I think the answer is a hesitant yes, in as much as data can be used to predict trends in other areas, in voting intention for example.

Lord Macdonald of Tradeston: But you are not aware of any projects at the moment to try to monitor that potential problem?

Hugh Milward: I am not.

The Chairman: Mr Mairs, you want to come in.

Chris Mairs: Yes. I was going to say—and it does not directly answer your question—that I do think that it is incumbent on government to become extremely skilled at using social media, because the person who is probably best positioned to monitor and do something about this is government itself, so it needs to become a really skilled user of these technologies. I do think that as a nation the best way we can mitigate these things happening is by doing as much as we can to educate our new upcoming workforce to benefit from the technology changes, because the changes are going to happen, and if we do not educate our own population, people will come in as migrants with the expertise and take the better jobs. So we just have to mitigate as much as we can.

Mike Warriner: The only part of your question I slightly take exception to is this idea of a technology shock. To me that implies that on one particular day suddenly a whole industry is going to fall off a cliff, and I do not see that happening. This is a change that could take many generations. We are seeing very, very rapid change in some areas and very exciting change in some areas: creating tonnes of new opportunities and enabling hundreds and perhaps hundreds of thousands of small businesses and people to have new jobs. I think we should be focusing on making sure that we accelerate that side of things and accelerate the new jobs that will get created from this change, and on making sure that through education anybody who is affected, as they get affected, can take advantage of these new opportunities. But I do not think we are going to see a seismic shock in the same way that we have seen with changes in the past.

Q49 Lord Kirkwood of Kirkhope: I am particularly interested in how Governments should be responding to the digital-divide implications particularly of the clustering at the moment, because that is an important part of our inquiry. Before I tease my way into that, I am a non-executive director of the Wise Group in Glasgow, which gets people off benefits into work using programmes. As part of that I see very bright 18 or 19 year-olds who are very skilled gamers. They get high scores on all these games, and they come in and say, "I cannot get a job". My question is: is it completely stupid to think that if the technology was crafted skilfully by educationalists, you could not say to somebody, "Look, here is a package that starts from zero in terms of computing science. Go away for 18 months and spend as much time on this package as you do on whatever the game at the moment is"? How realistic would it be to encourage an 18 year-old who is not frightened of computers because they use them to get themselves into a better place merely by self-tuition inside the module? Is that a daft idea?

Mike Warriner: No. That is a fantastic idea and I think we should be doing it. I think it is a fantastic idea. I think we should be doing it through and through. Microsoft, to give them a plug, have a wonderful piece of software, which my nine year-old is using, for learning programming at school. He is very fortunate to go to a school that teaches programming and

ICT separately, or computer science and ICT separately. In computer science lessons they are learning Scratch, which is a very visual way of programming. They are also moving on to a Microsoft platform—Hugh will have to remind me of the name—which is a Microsoft game within which you can learn to programme within the game.

Hugh Milward: Kodu.

Mike Warriner: Kodu. Thank you. It is an absolutely fantastic piece of technology. He loves it. As a nine year-old that is a wonderful way to learn. Also they are playing things like Minecraft. Somebody has built an 8-bit computer in Minecraft and you can type in questions and do math and stuff. You can use these games to play, and I totally think we should be doing more and more of that.

The Chairman: And more that is enticing for an older age group.

Mike Warriner: Absolutely, yes. Totally.

Chris Mairs: I was going to mention an organisation called CoderDojo, which is an interesting organisation in this space of self-taught skills. They aim at five to 19 year-olds, I think, so it is possibly younger than the group you are talking about. CoderDojo looks like chaos apparently because it is all self-taught. It is all about creating an environment where all the kids teach each other and teach themselves. There is this little bit of facilitation and they only have one rule, which is "Be cool". They started out with 10 rules about what you were not supposed to do and then got down to the one rule, which is just "Be cool". It creates a learning environment where some kids progress fantastically quickly and there is no formal training but nonetheless the kids acquire a deep set of skills and then go on and become professional programmers.

The Chairman: Thank you. Mr Milward?

Hugh Milward: I have one additional point. The thing about being self-taught is that you have to teach yourself. That requires a certain level of motivation.

The Chairman: That is the question in a sense that we were asking, yes.

Hugh Milward: Yes. It is the same with everything across technology: the better the design, the more thoughtful the design—this is the creativity that the UK is so good at—and the more a particular piece of kit will be used. The gamification of learning is what we talk about. It can be very powerful, but at the same time if it is too wordy or leads too directly to learning rather than fun they need to stay with it, and that is a challenge.

Lord Kirkwood of Kirkhope: That is exactly the point. I see the brighter ones. A light goes on in their head and they think, "I am done with this indolent life", if you want to use pejorative language. They want to do something, so they come to the Government and the Government say, "Well, the work programme is where you want to go", and that is not always an enlightening experience. If we had a package of the kind that you have just been explaining to us, that would be good. That is a very helpful answer.

I am running out of time, but I need to ask you about the cluster effects and whether Governments should even be thinking about trying to direct how some of this is rolled out in the future in order to try to deal in some way with the societal effects. Politicians will always be frightened, particularly, as Lord Macdonald was saying, if the disparity gap gets too big.

There will always be a temptation for government to say, “Let us take it to Easterhouse”, or whatever.

I would like to be comfortable that if we make a recommendation in this field we know what we are talking about and it makes sense. How does clustering and other effects—the things we are talking about this morning—have an impact on inequality, and how should we be remedying that if it is at all possible?

Chris Mairs: Just repeating slightly what was said in the previous session, I do think that clusters are a good thing, and you are not going to stop them because the small companies around the larger companies get huge benefits in terms of spin-offs to start new companies, recruitment and cross-fertilisation of ideas. Clustering has always happened in every industry.

Going back to the car industry, for example around Birmingham and Oxford, you get massive, massive numbers of SMEs setting up around the big players. Establishing new clusters is entirely possible with the right infrastructure, the key things being good transportation links, very good communication links and one or two key players in there to start, which is either a strong university or a very strong tech company, and that can regenerate an area quite significantly. In the north-east, for example, they are doing great stuff up there.

The Chairman: Unless you have anything different to say we will leave it at that, because in a sense we had that in the last session as well. Thank you very much.

Lord Kirkwood of Kirkhope: That is very good, thank you very much.

Q50 Baroness O’Cathain: Coming back to the gender problem, how can we get girls interested at a very early age so that they will take their place right alongside the chaps? I will not say make it sexy—I do not think that is really what I mean—just that it is a normal thing to do.

Hugh Milward: It is such a challenge. I think we are all agreed that we could do so much to close the skills gap if only we had more women involved in technology. It is more significant than that inasmuch as innovation requires people who do not all agree and it requires a different set of ideas to be brought to the table. Diversity is extraordinarily important within the technology sector.

There is also evidence to suggest that girls who learn computing in a single-sex school tend to stick with it a bit longer than in a mixed school, partly because they begin to take a seat at the back of the class and tend to let the boys push themselves forward in this area. Inherently it is not a gender-specific role at all, but it has this perception.

There is a lot that we can do as a sector by coming together and communicating a bit more effectively on the value of technology as a career option or as a skill that could be used throughout life and can be picked up and put down as people progress through life. There is a lot we can do through marketing. For example, in our apprenticeship programme we have only managed to lift the numbers of girls applying by marketing quite specifically to girls. Maybe there is a role in that as well, but it is a challenge and it is something that we are spending a considerable amount of time thinking about.

The Chairman: Does anybody want to add anything to that?

Mike Warriner: Possibly three things. We need great role models, and historically there has been a dearth of great female role models who you can reference and say, "Look at this person, they are showing how fantastic things are". We now have things like the Anita Borg scholarship. We increasingly hear stories from people who were at Bletchley Park. It was run by women, it was set up by women, and the people who come out of that environment are at last telling their story. I think that is very, very important.

Secondly, we need to take the way we think about technology and transpose it so that it lines up with the way small girls think about technology—and I use the expression critically. My son loves Lego and plays it the whole time. My daughter, who is seven, was never really into Lego. Then someone found some Lego that was appropriate for her and suddenly she has really got into it. It was for building boats and houses instead of tanks and machine guns, which is stereotypical but you understand. The skill we are trying to teach is how to build things with Lego, not how to think about aeroplanes. That is important: making it appropriate.

The third thing, again, comes back to careers advice. We have some great female engineers at Google. I was talking to one of them the other day and she said that her parents are still—she must be 30, I am guessing—asking her when she is going to get a proper job. That is not right. The role of organisations such as the BBC are going to help us change the game.

The Chairman: Yes, that is really interesting. Thank you very much. Finally, Lord Janvrin.

Q51 Lord Janvrin: You might have heard us ask this question at the end of the last session. We have to come up with a set of recommendations to government as to how we can improve the UK's competitiveness in this sector. What would be your top recommendation? If you want to have three, tell us your top one but give us the other two as well.

The Chairman: Yes, who would like to kick off? We already have the one about the technician in the schools, so that is good. You have time, Mr Mairs, if you want to think of a second one while we go to the other two, because you have already come up with one. Mr Milward.

Hugh Milward: Okay. What about Ofsted measuring the take-up of technology or the use of technology in schools as a formal measure for performance at schools? A thrust in that direction might encourage schools to think about it a bit more broadly. It is possible.

Mike Warriner: The number one thing that can make a change is investing in our teachers, whichever type of teacher we are looking at, and helping them to understand how they can teach technology to those aged five to aged 95 and use technology to change the way they teach it. Building on that framework is absolutely critical.

Lord Janvrin: You mentioned ages five to 95. It is a cultural shift for of everyone, us included, to think in terms of lifelong learning. How are we going to achieve that? Through teachers, as you mentioned, but there is a wider issue about how you change social attitudes to lifetime learning.

Mike Warriner: It is very difficult. I do not have the answer. One thing I observed while thinking about today was that if you do a science subject, typically you leave university knowing how to learn and how to do your first job. If you do let us say law, typically you leave your first law qualification knowing how to do your first job. That difference is the cultural difference that we need to instil. It is teaching people how to learn at work and to be

agile so that they think, “Things will change. I will not be doing the job I started at age 21 at age 65”.

Q52 The Chairman: Is there a role for business in that as well, because in a sense we have talked about the role for government? Mr Warriner and Mr Milward in particular, what is the role for you as businesses and with your workforce? How do you already, if you do, make sure that it is a continual education?

Mike Warriner: The way we recruit people and the skills that we are looking for in the people we are recruiting is interesting. For our engineers there is a baseline: we like the people who have done a computer science degree. We are looking for people who have done a computer science degree because that has taught people how to think and how to learn about new technologies and new ideas.

We are much less interested in whether someone can use programming language A or programming language B, because we know that in the first project they go on they will be using programming language C. We know that in 20 years’ time none of the languages they have learnt will be relevant. We are looking for that ability to learn and we want to encourage people—we spend a lot of time investing in people—to help them develop those skills and that agility. That is where business can come in: to help that.

Hugh Milward: Maybe you could fold out some of the internal training and make it available externally. At the moment we have every possible level of technical training, although not so much entry level, available to staff effectively through an internal MOOC. We have now folded it out so that anybody can access it, do the training modules and help. It does not get them on the ladder though; it supports them once they already have a basic level.

We all know that China is producing 40 computer science graduates a day, Poland is producing four and the UK is producing less than one. We need to do more to start it off at the beginning, but once they are there, companies like ours are doing an awful lot of folding those out.

The Chairman: Mr Mairs, do you have any other ideas? We are very happy with the one you have, but this is your final chance.

Chris Mairs: Just building very slightly on what Hugh and Mike both said, I cannot stress enough how much of a challenge the teachers at primary schools and at KS3 in particular in secondary schools, are facing with the new curriculum. A lot of these teachers have never been taught computing themselves, so it is a big challenge. They need to be demystified and helped. It is so important, for the reasons that Mike articulated, that this is not about teaching people to code, per se, but about using that as a vehicle for teaching them flexibility and a way of thinking that will help them in the new world.

Coming back to what Hugh said about Ofsted, there is a specific thing that Ofsted can do, which is that, probably in about 18 months’ time, it might be extremely valuable to do some research and surveying in schools, not as a stick but as a means of understanding how well they are now managing to deliver this new curriculum. In 18 months’ time we might find that significant intervention is required.

The Chairman: That was really helpful. Thank you very much indeed. That was a really useful session.