

# **Prof William Webb**

### Interviewed by

# **Richard Sharpe**

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### At the

### **BCS London Office**,

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Copyright Archives of IT (Registered Charity 1164198) Welcome to the Archives of Information Technology, where we capture the past and inspire the future. It is Monday the 2<sup>nd</sup> of March 2020, and we are in the City of London, in the headquarters of the British Computer Society. I'm Richard Sharpe, and I have been covering the IT sector since the early 1970s. IT is made up of two wings, communications on the one hand, and computing on the other. And from the communications side, making his contribution to the Archives today we have Professor William Webb, who has, although only 53, a long career, and also a large number of publications to his name. And we are going to look at his career, which particularly focuses on wireless technologies.

Mhm.

[00:49]

Now, Professor Webb, you were born on May the 4<sup>th</sup> 1967.

Yes.

#### Where was that?

In Hersham, near Walton-on-Thames, so in Surrey.

#### Right. What were your parents doing?

So my father was actually an engineer. He worked for, Decca, originally, which then became Racal n the end, mostly on radar systems. My mother was, was mostly a housewife, although she became a secretary in latter years.

So, this wireless stuff was sort of, in your blood, from your father's side.

Yes. Certainly there's, there's a clear pattern there. Although interestingly, I don't, didn't feel like I was ever steered towards being an engineer. But I think it, it was just one of those things that, I grew up in a house where it was natural to fix anything that was broken, and, tinker, and that I think became part of my psyche as well.

There is an engineering typeset and, a mindset I should say, which is, things can be made better, they can be fixed.

Yes.

#### Is it right?

I think that's absolutely right. So I think, there's probably personality types as well. So I think engineers tend to be more introvert, more interested in the way things work. But I think you're absolutely right, that... But I think it's, it's less prevalent now, but in the past of course, you had to fix, because, there was nothing much else you could do. Today you tend to, just replace.

Right.

And I think that mindset perhaps is missing a little from, from today's generation.

Your father had been to university?

Yes, he went to Exeter University, yeah.

Where?

Exeter.

Exeter. With an engineering degree?

I think it was. I can't remember now. If not, it would have been mathematics or something like that. But certainly a, a STEM type degree.

[02:28] And you went to a primary school presumably?

Yes.

#### Did you enjoy it?

I can't remember much about it actually. So I guess it was fine. [laughs]

You went on to secondary education?

Yes.

By then, the Eleven Plus was dead I think. So you no longer had to pass the Eleven Plus?

No. And, I did actually... My parents toyed with the idea of sending me to grammar school, and I did take the, the entrance exam, and passed, but they decided in the end that they would prefer to spend their money on other things. So, I went to a standard state school. And, that was, I think, fine I think.

What did you...

Nondescript.

Sorry. It was nondescript?

Yeah. I... It was a pleasant enough time. But I think it was still early in my, my life. I was... I was moving towards science type subjects at that time, but, of course you do a fairly broad range of different topics still at that stage, so, I think I did the three sciences as part of my, what were O Levels then, but amongst, English lit and language and all the other kind of things as, like that too.

#### What did you for your A Levels?

So I did, five in the end, of which one was a bit of a cheat, but I did maths, further maths, physics and electronics, and then I also did statistics, but, but you cover most of the statistics in maths and further maths, so, in a way you get that one for free as

well. So, so a pretty mathematical one, but with an electronics bent then starting to appear at that point in time.

#### Do you see the world in terms of mathematics?

Only in practical ways. So I quite like maths when you could relate the problem to something practical. Someone's digging a hole, someone else is filling it in; how long does it take to finish? Once it got to the very pure theoretical maths for the point of maths, I didn't enjoy that, I didn't get on well with it. So, so I don't try and conceptualise everything mathematically. But certainly, yes, if I, if I ever hear of a problem, my first instinct is to get a bit of paper down and write out the equation that the problem is, and then, and then try and solve it through that, that way.

We were interviewing Fullagar, Paul Fullagar recently, I don't know whether you know of him.

I know the name.

You know the name. But, he sees, he sees numbers as colours.

OK.

And I asked him, 'What's the colour of ten?' He said, 'It's white.'

[laughs]

Do you see numbers...

No. No, I certainly don't see that. I, I it as a useful abstract tool, but I, I don't have any visualisation of, of numbers as such. That's interesting.

[05:02] Were you destined to go to university, do you think? I think so, yeah. I think it was, very much expected. I never felt that there was any doubt about it. My parents were always, didn't force me, but, but I think they always showed that they expected that to be a route that I would take. I was doing very well at O Level, got very good O Level grades. So I think, you know, that, that made it pretty obvious I was going to get good A Level grades. So, I think, there was never much doubt about that. I think the only, the only question really was whether it would be an Oxbridge university course or not. And in the end not, actually. Although I got offered a place at Cambridge, at the time they were only offering general engineering courses, and not divided up into electronic engineering and other topic areas. And after much discussion with potential employers, I came to the conclusion that doing general engineering wasn't the best way to get into electronics, because, you were left with only effectively six months of electronics at the end of it. So that steered me towards Southampton actually, which was thought to be at the time the top university for, for electronics in the UK.

#### [06:09]

#### When did you meet your first computer?

Oh that would be a, a ZX Spectrum, which my, my parents bought for me, how old would I have been? Probably, probably be about fourteen or fifteen at that point in time I think was the, the first time I really had a chance. I guess, in a few previous years I might have been to science open days at various places where you could tap on a console, but, that, the ZX Spectrum was the first time I really got my hands on a computer and, had a good play with it.

#### Did you enjoy programming?

I enjoyed it a lot actually. And in fact it was one of my sources of income when I was doing my O Levels, I would dream up games, send them into magazines, and you'd typically get, £20 or something if the game was published in the magazine. Which at the time was a, a week's paper round money or something, so it was just as good an income as, as getting up each morning early. So, so yes, I, I did enjoy that a lot. And, you know, those sort of computers were great to learn on actually, because, they had a

very simple programming language, and, they sort of autocorrected to some degree, so it was pretty straightforward to write code for them.

Apart from for the keyboard.

Yes. The keyboard was a bit squishy, but... [laughs] I didn't know better at the time, so, that was fine.

[07:22] So you went to Southampton, yes?

Yes.

And this was your first time away from home, was it?

Yes.

How was that?

That was fine actually. I was in halls of residence for the first year, so, in catered halls of residence, so, that meant most of the practicalities of life were, were taken care of fairly easily. And, yeah, it was a reasonably supportive environment. So, I quite enjoyed that transition actually.

And this was up until 1989.

Yes.

You graduated with your B.Eng, First Class.

Yes.

In 1989.

That's right.

#### You are an academic highflyer, aren't you?

Yes. So, I got the top First from Southampton, and indeed I think I got the top year prize for every year I was there. So... And that at the time was considered to be the top university for, for engineering. So, yes.

#### That must give you a lot of confidence.

It does. [laughs] Because, there are always times of self-doubt, and, then you sort of think back and think, well actually, if I achieved that, then I must, must be reasonably good.

#### [08:36]

Well you did do it. And so you came out in '89, and you walked straight into a job with Multiple Access Communications.

Mm.

#### Who was that and where were they?

So, that actually came about through my last year at university, when, one of the courses I particularly enjoyed was the, the communications course that was given by Professor Raymond Steele who was, reasonably well-known in the industry at the time. I enjoyed it, I was, I would chip in quite a lot during the lectures, and at one point at the end of one lecture he said, 'You know what, you're the first person to spot that particular error in my notes that I've been using for years and years and years. Clearly you're, you're interested and you're clued-up. Would you like to, to do a PhD for me?' And I said, 'Well, I quite like the idea, but I don't want another three years without any income.' And so he said, 'Well, that's fine. I've got my own small consulting company. Why don't you join that, and whilst you're doing that, you could do a PhD part-time, because it's highly likely that the consulting company will have projects that would be a viable basis for your PhD, and you could do that.' It

seemed like a great idea to, to work with someone who looked like a very interesting character, and to get a PhD and a job at the same time. So, so that's how that came about. Multiple Access Communications at the time was, three people big. It's I think now 20 or 30, so it's grown somewhat over the time. And he was absolutely right, almost immediately a big contract came from BT, which was a, a large chunk of research work that they wanted doing, which was clearly a great basis for my PhD. So I did that essential part-time.

#### Why wouldn't BT do that research themselves?

They could have done, because they've got their own research labs, but, they were very keen to pick up on Government grants and European grants and some of the things that were taking place at the time. And one of the, the requirements of one of these grants was that they involved SMEs, small and medium size enterprises and academics and others in a, in a team to pick up the grant. And so I think they felt that, Multiple Access was a great vehicle for that, it was kind of a, a mix of academic and, and consulting, and an SME. So, they sort of, bolted into that. And, and that became my PhD, which was, which was a great step.

[10:57]

So Multiple Access Communications, there's a clue in the title really.

Mm.

We're talking about the late Eighties here, and early Nineties.

Yes.

It was still relatively novel, was it not, for a leading academic to have a consultancy outside?

Yeah, absolutely, it was pretty unusual actually. And, you know, now I think we're a bit more used to academics doing things on the side, but back then, I can't think of any others that were doing this. Yeah, this, the guy that was running it, Raymond

Steele, was a very unusual individual, which is why I liked him so much in a way. He was fun, different, had quite a varied career, working for research labs and things all around the world and so on. So I think he was willing to push the boat out a bit, to do that, and happy to take a few risks, and, potentially wind a few people up the wrong way, but that didn't seem to worry him too much, as a result.

#### [11:49]

#### So what was actually your PhD about?

So, the idea of the PhD was to try and look at ways to transmit mobile data faster. So this was back in the days when, you could have a mobile phone, but, you didn't use it for data very much. And we were just starting to think about phones that might have data capabilities, but with data rates that today would look pathetic, tens of kilobits a second. And, the thinking was, well we might need to get to, to megabits a second at some point in the future, so we should start working on mobile phone systems that could do that. And, one of the ways to do that was to change what's called the modulation scheme. So, essentially, the number of, various discrete points that you could use to send data on, and as you increase the number of points you can send more data. But it becomes more likely to be corrupted in that process. So, so the question was put, could you, could you do something, could you come up with some way that allowed you to use more of these modulation points, but over, but didn't suffer from this problem of data corruption? And actually, through the PhD I came up with a concept which is now used very widely, and sounds very straightforward, but wasn't really thought of at the time, which was, well, why don't you dynamically vary the number of points so that as you walk along and you move through periods of good reception and bad reception, or you get closer to a base station, you make the most of the system. So, where you've got a really good radio signal, you can have lots of these points, because there's very little noise and interference, but where the signal weakens, you drop back to a smaller number of points. And you effectively change the number of points every millisecond or so to adapt to the radio environment. It's called variable rate modulation. And at the time it wasn't used at all. Now it's inherent in everything that we use, and that's why when you take your laptop further from your Wi-Fi router, you'll see the data rate drop that you can deliver; essentially it's reducing the number of those modulation points according to distance. So that

was what the PhD was about. Interestingly, because it was sponsored by BT, they did actually realise that it was quite a useful concept and they patented it. But it then got kind of lost in the BT patent pool, to be sold on to BlackBerry, or RIM, the owners of BlackBerry, some fifteen years later, who then went to exploit it, and managed to for a little while, but it was, it was almost expiring its time by then. But BT missed a bit of a trick there, they could have probably used it a lot more than they did.

#### You were not allowed to patent it?

No. So, because BT were paying for the work, as, as is pretty much always the case, they have all the rights to, to patent stuff. And, and to be fair, even if I had the rights to do it, I suspect I wouldn't have had the, the wherewithal and the knowledge and, to, to go out and, and take out a patent on it. But, I might have been a lot wealthier had I done so, but, it doesn't matter.

#### [14:50]

And in doing that, you must need to have quite a bit of computing power to be able to do that dynamically.

Mm. Yeah. Absolutely. And, certainly back in that era, there was a lot of ideas that were, that were out there that just weren't implementable or feasible essentially. The computing power was still catching up with the systems. And so actually, I, I did manage to knock up a sort of prototype solution that, that showed that it worked on multiple circuit boards, but it wasn't really viable to do it with the technology of the time. But then, Moore's law and the improvement in chips and so on was happening so quickly, it was probably only another three or four years later before it became a feasible thing to do in, in systems. And now it's almost trivially easy to do, given the power that we've got today.

We'll come back to Moore's law.

Mm.

I'm sure we will.

Mm.

[15:41]

Then you moved, from, '93 to '97, four years, you worked for Smith System Engineering Limited.

Yeah.

Where was that?

That's in Guildford.

Right.

Yeah.

And what did you do there?

So that's also another consulting company, a much larger one, so I moved essentially to, to try and gain more experience in a, in a bigger environment. Smith's was an interesting company, set up by Bruce Smith, an academic, a mathematician, on the basis that, if he assembled what we might think of today as rocket scientists essentially, a group of great people, and then went out looking for difficult consulting problems and fired them at them, he could generate a lot of value. So, it was a very elitist consultancy. That was fine, interesting and different. A lot of its work originally had been defence related, but it was now branching out into communication. So I joined essentially a, a relatively new element of it, but a growing part of it, in the communications space.

Guildford is a centre of, University of Surrey.

Correct.

#### Was that connected with it?

So, it was certainly on the University of Surrey's science park. I don't think there was actually any other link to the University of Surrey though, interestingly.

#### But you are connected with the University of Surrey now.

I have been. So I was a Visiting Professor; no longer one, and we'll probably come back to that, because of my views on 5G, and, which didn't quite align with the, with the university. But I still, that's something to circle back on when we look at the, the later years.

#### [17:10]

#### What were the best times of your days in Smith System Engineering in Guildford?

Yah. So, it was there I started to look at radio spectrum and the management of radio spectrum. And I think that was some of the most interesting challenges and interesting problems. So actually, during my time there, the, the UK body that was responsible for radio spectrum, it's now called Ofcom but back in those days it was called the Radio Communications Agency, had a new CEO, who was quite keen to use new economic tools to try and show how valuable radio spectrum was to a country, and then...

#### Who... Sorry. Who was that person?

Jim Norton. Who actually then went on to become President of the BCS I think some time. So, yeah, there's lots of links in, in the world. So he commissioned some, some consultancy to, to try and determine how much radio spectrum might be worth, and then determine how you might price it and sell it. And to do that, we put together a team of economists and engineers, and I was the engineer, working with an economist. And we produced a couple of, of pretty seminal pieces of work. One was called the economic value of spectrum, which showed for the first time that radio spectrum contributed at a minimum something like three per cent of GDP each year, which actually doesn't sound too surprising now, when you think about all the things we use radio spectrum for, but, but back then, nobody had got any view of its value as such. So this was quite sort of, interesting. to suddenly think, actually, it's not just some backwater that I have to manage as part of a bigger portfolio; it's quite an important resource. And then we moved on to, to looking at how you might use economics to, to price spectrum, and that became spectrum auctions and so on, which we're now used to with spectrum being routinely sold by governments and all of the mix of, of what goes in there. So, that was, that was interesting, interesting new bits of work. And then, I did quite a lot of kind of similar or related studies around the world. For example in South Africa I helped re-plan their complete radio spectrum allocation, as they were effectively transiting out of the apartheid era and looking to, to do things renewed and afreshed in a, in a new way. So... There was other things as well.

#### [19:31]

Perhaps one of the other interesting projects was, I was the lead architect on the railway system, on the radio system that the railways still use, GSM-R it's called, GSM for railways. At the time GSM was the phone system we were using. And I effectively designed and implemented a modified version of that that suited the railways particularly.

#### Because the railways are quite a harsh environment...

#### Yes.

#### ... for radio communication, or wireless as you call it, sorry.

Yeah. It's a mix of that, and also, they had some, some different requirements than, than people. So, for example, they, they like to be able to what's called group calls where they might call all of, all of the people working in an area. Now that's a sort of walkie-talkie kind of thing. But if you're going to use a cellular phone system, that's much more difficult to, to engineer. And also, very high speeds of course, trains can travel up to, to two or three hundred miles an hour. And the Channel Tunnel had just been designed, so we needed a system that would allow trains to, to move through multiple countries and still all use the same radio system. So, so quite a few different things to throw into the mix there.

[20:37]

So governments across the world were suddenly told, by people like you and by economists, 'You don't realise it, but you're sitting on a bit of a goldmine.'

Yup.

It's called spectrum.

Yes.

And people like Gordon Brown say, 'Tell me that again. Do you mean I can make money out of this?'

Yup. Yup. [laughs]

And you said, 'Yes, you can, Chancellor.' And he made a lot of money out of it.

Yeah. And that's not something I'm particularly proud of as such. So, what we actually said was, not that you can make money out of it, but it was a very valuable resource and therefore needed to be managed very carefully. Not necessarily as a way of extracting money, but, as a way of making sure that the best use was made of the spectrum. So, if you go back to, to the early days of mobile phones, there was very little spectrum available for mobile phone systems. The vast majority was used by the military, or, at least, not used by the military, but, they just sort of, grabbed it. And, they would look at it, and say, 'Well, you know, we'll just hang onto this.' [pause] And, that was not a very efficient use of the spectrum. So, to be able to say, 'Look, if you could get the spectrum back from the military, and it could be used by the mobile phone companies, that could generate enormous value for the country. And even if you've got to pay the military a bit to do that, it's worth that, that kind of a transition.' So that was the key message. But unfortunately, and it's still the case now, many governments say, 'Well actually, you've shown it's valuable; that means I can get lots of money.' Is that a good or a bad thing? I mean, in the end I don't think it makes a lot of difference in so much as, the Government takes money off the mobile phone

companies, therefore they have to charge the likes of you and I a bit more for our mobile phone contract. But in principle the governments now tax the likes of you and I a bit less, because they gain money from a different source, and therefore, net net is probably more or less the same outcome, but, [laughs] but it's not the ideal approach for the industry.

#### [22:32]

Did your economist friends tell you that the Government was charging too much for this spectrum?

So, at the time I did the work, the Government wasn't charging anything for the spectrum. And therefore actually, the economist friends said that governments should charge more. [laughs] But now I think, as we now look back on it, the key turning point was, the 3G auctions that took place in 2000, when in the UK, I think something like £22 billion was spent by mobile phone companies, way above anyone's expectations, because of course you never quite know with an auction where it's going to end. And that was the point I think where suddenly, the likes of myself and the economists said, 'Hang on, that's too much.' [laughs] We've gone too far the other way in this process. But... And we've never seen anything quite so extreme as that; the latest auctions were more like, two or three billion, so, one-tenth. But even so I think there's still some doubt as to whether that's still too high, particularly if we're looking for mobile phone companies to achieve societal benefits like, more extensive coverage than we have at the moment.

#### [23:38]

And once TV goes digital, you've got all of that analogue signal so to speak that you can use.

Yes. And in fact I was part of the process for, for showing that if you, if you did that, then you would generate some spectrum, and that spectrum was valuable for other things. And therefore, you could actually effectively cross-subsidise. It was worth paying the BBC and ITV essentially to, to go digital, because, that money would be returned many-fold by giving it then, or selling or whatever to mobile phone companies, who could then make a much much more efficient use of it. And we still

go through that process today of essentially being able to work out, start to use economics to work out how best to, to attribute the radio spectrum to various things. It's an interesting... It's always changing, because technology changes what you can do with the spectrum, and, and how much it's worth to different users at different times.

#### [24:35]

Although you're a very high-powered engineer, from what I can see, do you like to work instead, not just in a pure engineering role, but also in multidisciplinary projects?

Yah, absolutely. And in fact, that's my preference actually. So, very early on in my, my career, I, I did start to find the whole strategy side much more interesting. I did an MBA, just because I wanted to effectively get more background into, into how to do strategy. And I love the projects where there's a mix of, of economics, but politics to some degree. I'm not, not a politician in terms of office politics, but I like the sort of bigger picture kind of, what's the best thing for the country, how does that fit into the overall objectives of, of various governments and, and ministers and things like that. And, you know, yes, definitely like working in, in larger reams. And probably, I don't know, three-quarters of what I do nowadays is probably with a mix of economists and strategists and lawyers. So, yeah, absolutely.

#### [25:42]

So four years of Multiple Access Communications, four years at Smith System Engineering Limited. And then one year at Netcom Consultants.

Yes, that was my first mistake, over career. So, at the time a new concept was just starting to emerge, which was, which was called wireless local loop at the time; it's now sometimes called fixed wireless access. The idea was that actually, if you wanted a broadband pipe into your home, you didn't necessarily need to do that via copper cables, but you could do it via radio signals. And in fact a number of companies sprung up in the UK and elsewhere. There was quite a major one in the UK called Ionika at the time, which didn't last very long, subsequently went bust, you know. But there was a lot of interest at that time in that, in that area. This consultancy Netcom said that they were going to major in that space and asked me to come and run that group. When I got there, I discovered that actually, it wasn't anything like I expected. I wasn't being given the role that I thought I was going to be given. And, there was something very odd going on, and I wasn't quite sure what, but I didn't like it. Subsequently, after I had left, the CEO was indicted on fraud and sent to prison. So, whilst I didn't know that there was fraud happening, I was kind of, it just didn't feel right. And so, almost immediately I arrived there, I started trying to work out how I was going to get myself out of there. [laughs] But I didn't want to leap straight into another bad job, so I carefully, looked around for a little while and then moved to Motorola.

#### [27:11]

Now this is interesting, that you moved to Motorola. You've been working in relatively small companies.

Yes.

Now you move, and this is 1998, and you stay with Motorola till 2001.

Yes.

Now here's a, obviously an American company, based in Chicago. Very long lineage.

Mm.

Radios in cars, that's really where it comes from isn't it?

Yup, absolutely. And that's where the name comes from in fact, motor from motor car, and rola from, the, the word that's often added to the end of, pianola, or, similar kinds of things.

Exactly. And a company that had been very big in chips for example.

Mhm.

Very big in mobile, and, even was building its own mid-range computers.

Yup.

It had lost its way, hadn't it?

It had.

Badly.

Yes. And, and went on to do even worse than that. So, so I joined them, I think partly because, I felt I ought to have some big company experience in my background, and partly because frankly I fancied a posting to the US, and joining a US-based company seemed like a great way to do that. It just felt like an interesting thing to do, to go and live somewhere else and spend some time somewhere else. So, so there was certainly that element to it. But as you say, at the time, Motorola was, looked like it was flying high. It had just come out with the StarTAC phone, which was the sexy phone that everyone was using in all the films, that you flipped open and so on. But telecoms itself was also riding high. This was just before the dotcom bubble burst. So it felt like an interesting company to go and join. And it was interesting in many ways, but, what I discovered... I, I moved... I started off in the same wireless local loop space, but then, I moved to corporate strategy, where actually I was, I was very lucky to be in a position where I was working, somewhat closely with the CEO, but also had access to his father, the previous CEO. So, Motorola is a, very much a family business, it was founded by the Galvins, but the founder was effectively the grandfather, and then, there was the father who was CEO I think from the Sixties to the Nineties or something like that, and then there was the son, Chris Calvin, who took over in the late 1990s. And working with them, it became apparent to me that, I don't think Chris would have ever made it to CEO if it wasn't for his family history. He was, he was a competent middle manager, but he wasn't a CEO. And he was essentially a rabbit in the headlights, he just didn't know what to do. And he didn't want to do anything much for fear of breaking the, the crown jewels. And, you know, I had plenty of ideas and concepts that I would push his way, but it was quite clear

that, that not much was going to happen. And then, when the dotcom bubble imploded, Motorola was particularly bad hit, I think everyone realised that, that it was a bit of a strategic mess at that point in time. And it just fell apart after that.

[30:03]

You were Director of Strategy ultimately.

Mm. Yes.

#### What strategy did you propose?

So, at the time my key interest was, was pushing Motorola more into Wi-Fi. So they were very strong on cellular, but it appeared to me that that was, that was going to commoditise. So the history of Motorola has always been, starting off in a, in an early product, car radios was one, televisions was another. Being a leader in that space. And then once it started to become a commodity product and manufacturing moved to, wherever, the Far East or whatever, then dipping out to the next big thing. Because, with the US cost base, you were never going to compete with others. And so, looking at that history, it had done well with the cellular handset, but it was clear that it was, that was starting to move on. And it just seemed to me that, adding in sort of, Wi-Fi, other systems, to make more complex communications systems, was a way that you could stay in that same broad space, but deliver a, a more interesting, more leading-edge product, rather than being commoditised. And Wi-Fi at the time was really something that was, a little bit used in, in corporates, but it wasn't the thing we think of today that's in every device. It wasn't in laptops or, or handsets or anything like that at the time. But, that just wasn't interesting essentially for the, for various reasons, including the desire not to rock the boat too much. And also the classic innovator's dilemma kind of thing of, well, yes, but that's just this tiny thing over there isn't it, Wi-Fi. We're the big boys in cellular; why would that be interesting? So, so I absolutely failed to, to really, come up with any, anything that stuck at Motorola, but I think, so did everyone in Motorola, there was nothing during that period. But a very interesting education in, in the ways of, of larger companies.

Well there were a lot of people at the time, very experienced people indeed, who were saying that Wi-Fi is a niche and will remain a niche.

Mm.

You were a bit of a maverick in posing a, a strategy based on Wi-Fi.

[laughs] Yeah, absolutely. And, that's, there's a little bit of, of being a maverick and trying, trying new things all the time. And, and I think, one thing I learnt was, that you have to be persuasive and you have to understand the politics of the situation. It's not enough just to say, here's this great idea, and logically it's the case, isn't it wonderful, it's, it's clearly going to, going to play out into the future. That doesn't help very often. And that was, that was a great learning from that time.

#### [32:34]

My research shows that you have a reputation for being able to forecast technology rather well.

Yes. So, I'm very proud of a book I published back in 2001, *The Future of Wireless Communications*, where actually I set out, I tried to set out some specific forecasts for 2010, 2015, 2020, with a sort of list of bullet points of, this is what's going to happen in those times. We're in 2020 now, and actually, it's pretty close I think. So people who would say, well, forecasting ten years is pretty difficult, 20 years is nearly impossible, not so, not so much. I think it's, at least if you're looking at general trends. I would hate to try and forecast which companies would be successful, because, a company's future can swing on the, the sense or lack of sense of its CEO. But, overall trends I think are actually quite possible to, to forecast and to look ahead.

#### [33:31]

When you take technology, politics, economics, and society, which are the bigger drivers of the way that technology will successfully be applied?

I would say probably economics is... So, I think, technology is actually a minor issue. Almost anything, apart from teleportation, is technically possible. So, it's very

rarely a case of saying, you know, what's technology going to allow us to do? It's more a case of, what does it make sense to do economically? But I think you have to look at that quite broadly. So, we tend to think of that as a large company making an investment decision. But also we think of it for ourselves. So, you know, should you buy a smart door for your house? Well, that might cost you £1,000. You don't then do a business case for that, but you might think to yourself, would I rather spend £1,000 on a smart door, or a new TV? Well, I'll have a new TV. So, so there's some economics in there, but it's not economics in the sense of, I'll go and sit down with a spreadsheet and work it out. It's, it's kind of, to do with personal preferences as well, but nevertheless, if the door was £5 rather than £1,000, you would probably have it. So I think that's by and large the key driver. I mean politics can, can either slow things down, or, can send you off in slightly different directions, but ultimately politics has to stay anchored in economics in the end. I mean it can, it can deviate off for quite some time, but, sooner or later, economics will, will pull it back in the right direction.

## So you do have an implicit model in your head of how these forces work together, and that allows you then to sketch out where the technology is likely to go?

Yeah, absolutely. And, you know, I think that was my, my big learning from, from my Motorola time and those initial forecasts. And I don't claim to, to have some, you know, wonderous rocket science model, but I think it's more just saying, OK, that technology is really interesting, doesn't it look fabulous, you know, we can, we can have folding screens on our mobile phone. Isn't that superb. Everyone's going to have a folding screen. But, but rather than doing that, I'll then have another little bit of my mind that will say, OK, interesting, I can see folding screens are quite sexy, but, how much would anyone really pay for this? Is it practical? What are the other things that are going to be part of that buying decision, and how will those affect what takes place here, as well? And, that's not rocket science, that's common sense in a way. But I think, a lot of forecasters can get too hooked up in the wonderful things that technology could do without actually asking us, well is that of any real value to us? And I see it all the time now, with things like, driverless cars now is another classic example of, yes, you can make the driverless car; it doesn't mean we're going to have

them in a few years' time. There's all sorts of other factors at play that, that will affect that.

#### This is again, back to your multidisciplinary approach.

Mm. Mm.

#### Although an engineer, you are a bit of a, an economist as well, to, to say the least.

Yah. And I think that's, it's clearly helpful to have multidisciplinary capabilities. I think it's fairly, fairly unusual, and I'm, and I say that because actually, as I said before, a lot of engineers tend to be introverts, people who are kind of, focused on problems. And I don't say that in any pejorative sense. I consider myself to be an introvert, so I'm not being critical of that. Whereas a lot of the other things like economics and politics tend to be things that people who are more extrovert are interested in. So, you do tend to get people that fragment into one of those two camps, and people who have sort of, got an interest to cross both spheres, I think are less usual than you might think.

#### [37:15]

#### Three years at Motorola. And what was the culture like living in Chicago?

[laughs] I loved it. Because it was different. And, at the time the US was considered to be a great place to live of course, and, we didn't have Donald Trump or any of that kind of thing. It was pretty... 9/11 as well. So those kind of issues hadn't really started to emerge. America felt still like the sort of land of opportunity, the land where everyone felt they could live the American dream. Chicago is actually quite a nice place to, to live. And, everyone was friendly and nice. It was also a time when we had two young children, and it's a really convenient place to bring up children. There's plenty of space, the restaurants all have, are all very children-friendly and so on. So, so it was, it was pleasant, convenient, an interesting place to live. I'm not sure it's a place I'd want to live forever. I started to tire I think of the, the lack of, for example, critical interviews on radio and television, so on, was... I think you always

miss the things that you are used to. But, those kind of things started to feel a bit, a bit superficial after a while.

But you do get plenty of ribs and a lot of jazz.

Yes. [laughs] Yes.

[38:22] So you decided to come back.

Yup.

And you worked for PA Consulting.

Yes.

#### For two years.

Yah. So that was, that was, to some degree a holding position in that, coming back from the US, it was very difficult to find, you know, the perfect job, because, it's quite a long way to go for a job interview for example. And unless you're kind of, in and around the area, and you're known to, to people who are looking for, for individuals, it's hard to, to find that place. So I, I happened to know PA, I had actually interviewed with them in the past, before I went to Smith System Engineering, and it just felt like an easy landing zone in a way to, to land back there. Perhaps that will go really well, and that would be great, and, and I'll have a new career in there. If not, then, I will be in the thick of, of stuff that was happening, which would position me well for, for the next thing. And actually, it was the latter that turned out. So, I came back in 2001. That was when the dotcom bubble had seriously burst.

#### Seriously.

And, it was very hard to find any significant amount of consulting work when I was at PA. So I spent all of my time trying to sell consultancy rather than doing consultancy.

I'm not that good at selling consultancy, and I didn't enjoy that at all. So, when the headhunters called with the next role, the Ofcom role, that seemed like a great step forward.

Right.

[39:46] *About the dotcom bubble.* 

Mm.

I also wandered whether you have any, I wonder whether you have any comments about Y2K as well. Perhaps you don't, not quite your area. You know, the...

Yah.

...2000, Millennium bug business. Was that a bit of a scam, or ...?

I mean I think it was a legitimate worry, but it got over-hyped a lot. So, no, yes there was a potential issue there.

Right.

But the fact, the thought that it was going to shut down the world was, was clearly overdone. And, so, I think, yes, a lot of money got spent, probably somewhat unnecessarily. It would have been much easier just to wind a few clocks forward and just see what was going to happen [laughs], than go to the extreme that they went to. But it wasn't something that I was involved in particularly.

[40:31]

No. Now, and another concern about this area is the, the dotcom bubble bursting.

Mm.

Now, I was writing about the whole IT sector in this period, and of course I was labelled as a dinosaur, because I said, it is not possible to have companies that have over 1,000 years of losses built into their share price.

Yeah, yeah.

It's just, not possible. Why are you paying this amount of money for...

Yeah.

... companies that are burning cash like nobody's business.

Yeah yeah. Absolutely.

And they said, 'No no Richard, you don't understand, the new economics...'

[laughs] And, you know, we're potentially in that, exactly that same space again with, with the Ubers and, and those other kinds of companies that are, new economics, so you can make losses forever, kind of thing, and...

Yes.

Absolutely. I think it was, it was pretty clear that that was, was crazy. I think that's, that's just the nature of humans and economics and, and bubbles, you know, it's, from the tulip bubble right through to the dotcom bubble. We never learn do we, kind of thing. But, there's a, there's a sort of semi-rational kind of thing of, well, I think this is all going to bust, but I might as well ride it up to the point that it does, and make some money. And of course, if enough people think that, then it just inflates, inflates, inflates until it does finally burst. It's not very helpful.

What were the first shares to actually drop in the 1929 radio company shares, because they were the leading edge and were being built up and up.

Yeah. And actually, back to our, our auction. The time that I knew something was seriously wrong was when I saw that 23 billion had been paid in the UK auction. And at that point, I had already sort of thought, mm, I'm not sure I'm going to be in the States much longer, I'm not sure Motorola are going to be around much longer, because, if your customer group is going that, and that's clearly nonsensical, then, this is all going to, to pop at some point in time. And I'm sure we'll see plenty more of that, indeed maybe we're about to see another, another burst right now, as, as some of these very high inflation prices are deflated by, whatever it might be, coronavirus or whatever trigger causes us to, to realise that it's all gone a bit crazy.

[42:37]

So your career has been moving in spurs of four two and three years.

[laughs]

And then, the headhunters come, and they said, 'Would you like to work at Ofcom?'

Yes.

And this is 2003.

Yes.

And you move to Ofcom. And you're there for eight years.

Yes well I was only meant to be there for four years. [laughs] Which would have fitted the pattern perfectly. And in fact, when I was offered the job, the, the guy who offered it to me, Ed Richards, who went on to become CEO, said, you know, 'We're assuming you're only going to do this for three years. And that's all we want. We don't want a, a permanent cadre of, of top people; we want to move things along quite quickly.' I said, 'Absolutely fine by me.' And actually, I did kind of plan what I was doing there to, to last about three years or so. Four, in fact, I think, it became clear it was going to take. So, so, got to the four-year point. I had just started to look around for the next thing, and, we were talking about bubbles, Northern Rock happened, and the, essentially the, the financial systems went into meltdown. And, I was hoping at that point to start up a company, and it was just, almost impossibly difficult to do at that point. Nobody wanted to, to offer venture capital funding for any kind of new idea, when the financial system was going into meltdown. And, after trying for a year or so, I got told quite widely, 'Look, you are in a, quite a good place right now. Stick it out for a bit longer.' So actually, I stayed at Ofcom for, I think three years longer than I normally would have wanted to, essentially waiting out the time for which the world became a place that was more inclined to invest in new ideas and new things. So, so yet again, bubbles had an impact on, on my career.

#### [44:15]

You were head of research and development.

#### Mm.

Perhaps policy, therefore, didn't come into your remit, but I think it has been said of Ofcom that it is a classic regulator which has been captured by those who it is meant to regulate.

Yes yes. So... Absolutely. I think that's, that's very true now. If I look at Ofcom as it is now, absolutely, I think it, it has been captured. So, Ofcom was an interesting ride, because, I joined it when it was formed. So, so it was a new body, formed by merging five separate regulators together from radio spectrum and telecoms and other things. But interestingly, it wasn't just the top people from all those bodies. In fact, 80 per cent of the senior management group were new to regulation, from, coming from outside, including the CEO. So, it felt almost like a start-up at the time. And we all came in with great new ideas about how we were going to change everything, and, we were going to ditch all the old regulation and come up with new ideas, and, and all that kind of thing. And I think for the first three years we did that actually, a whole, a whole raft of creative new ideas, new papers. I wrote the spectrum strategy document actually, which set the sort of overarching way that spectrum was going to be managed. And it felt like a time where we could do things differently. And then, gradually, regulatory capture happened; gradually, the honeymoon period was over; gradually companies decided they could litigate more and more. Freedom of

Information came in. That was actually quite a significant issue, because suddenly, you know, you could get random requests on, whatever, how many digestive biscuits have you eaten this year at Ofcom or something. And suddenly, you felt much more risk-averse, because, you knew that everything you had done could potentially be picked apart publicly. And all those factors I think contributed to, to Ofcom gradually getting captured by, by the bodies of regulators and becoming increasingly risk-averse. And in a way that's why, three or four years would have been enough for me. In the last few years it was increasingly frustrating, because, it was just getting harder and harder to get stuff done. And there was one point where, I had one idea that I particularly wanted to push, and I was told by the management, 'You can't.' And I said, 'Well I'm going to anyway.' And they said, 'All right. So be it. And your head will be on the block if it goes wrong.'

#### What was that issue?

So that was something called TV white space, and that was the idea of using these TV channels that we were talking about earlier, but using them opportunistically. So not waiting until they we cleared, but, but noting the fact that in some parts of the country some of them are hardly used, and being able to pop up and transmit on those channels without interfering with TV and disappear again. So sort of, dynamic use of the radio spectrum. Which, which had been put forward in the US, so it wasn't a, an absolutely brand new idea, but I was trying to take the US concept, improve it, and then drop it into the UK environment. Which I did, actually. Although I didn't quite finish it before I left Ofcom, and that was a slight hiccup, because, it then languished for quite some time before it finally got finished a few years later.

#### [47:20]

It's very interesting how you are not just sticking with one idea. You see this technology. I should rephrase this.

#### Mm.

You see this technology as much more dynamic, that it can be used dynamically. And I mean sometimes...

Yah.

...minute by minute, second by second. Rather than having to have a dedicated channel. This is your channel for this. Where did you get that idea from?

That's an interesting thought actually. So, I, I hadn't thought about that, but in a way that almost harks back to my PhD as well, the idea that things can be constantly changing, and moving, that you don't need to, to look at things from a static sense. I guess I'm, I'm often just looking at things and saying, can it be, can it be done better? Is there a different way to do it? And typically, that does involve... If there were a simple solution, of course it would be found by now, so, so it does typically involve some kind of dynamic approach of some way, shape or form to, to try and move things differently. But, I don't know, I'd have ponder that question further I think. I haven't sat down and thought to myself in the past, the answer to everything is, is dynamic, therefore, how can I apply dynamic to this?

#### But you have a model in your head.

Yeah. I think you're right. That's, that's an interesting comment.

#### [48:37]

There has been an argument put forward that, the amount of real innovation going on is actually dropping.

#### Mm.

Has been dropping, apart from two world wars, in the twentieth century, and all we're doing now is really, getting less bang for our buck, and having to spend more bucks to get that bang.

Yeah.

Do you get that feeling?

No. Not at all. And... No, I see those papers, and I see that argument, but, you know, I think to myself, if I said to, to my grandfather, that, you know, in his lifetime, say to when I was a young boy, in his lifetime there would be this pad you could put on his lap, that he could just touch it with his finger, he could access any information anywhere in the world, instantly, and you could do almost anything he could think of with this pad, that would have been seen as, as black magic. You know, think of, think of transformations that have happened in that respect. Now, yes, electricity of course transformed it too, but, but that, that ability to do that, which of course comprises so many things from touch screens to, to wireless, to the Internet, seems to me utterly transformational, the whole way that we work and live our lives through the Internet. And so, I feel that that is a more significant change probably than almost anything else I can think of. And, that's playing out now in good and bad ways in society of course, social media and all those kinds of things. But it just feels enormously innovative. And the amount of venture capital type money out there being thrown at problems, is huge as well. So, so I don't buy the, the end of innovation argument. I think it's different. But it still seems to me, there's a lot of stuff out there that is changing.

#### [50:31]

You left in 2011, you left Ofcom in 2011. And you were one of the founding directors of a company called Neul.

Neul, that's right.

*n-e-u-l*.

Yes.

*Neul.* And you played a substantial part in initial fundraising. So you are able to raise funds?

Yes.

And, your first round of funding of 10 million.

Yes.

You had the role of CTO.

Yes.

What were you trying to do at Neul?

So the idea of Neul was actually to build on this spectrum concept that I've talked about, the TV white space idea, and to make that with an idea that was growing quite strongly at the time, which was called the Internet of Things. And it's, it's still an idea that's with us. So, the idea that actually, we had connected most of the people, they had all got cell phones; now it was time to connect things, whatever they might be, dustbins, cows, refrigerators. That's a bit of a joke, but, you know, those kind of devices. And up till then, there had always been a bit of a question, how do you do that in a way that allows very long battery life, very low cost devices? And it was, hadn't really been resolved at that point in time. So, some things were connected using standard cellular, so vending machines started to have GSM cards within them, and they could send a message back saying, 'I'm running out of Mars bars,' or whatever. But, that was only suitable for a very small minority of these things. And what myself and a, another guy, James Collier, when we got together, thought was, actually, if we mate this new radio spectrum, this TV white space spectrum, with some, reasonably well-known technology, but, technology that's been particularly optimised for this solution, we can solve that problem. We can actually come up with a way of connecting these things that allows multi-year battery life, long range, low cost modules, and that could be pretty revolutionary. We could come up with the equivalent of Bluetooth for machines. And in fact, James Collier, my co-founder, had been right at the heart of, of Bluetooth. So, so he had kind of done the Bluetooth for people, and it seemed quite plausible that we would do the, effectively the Bluetooth for machines. So, you know, really exciting. And, for a while I think we were the, we had the largest series A venture capital funding of any Western European tech company at the time. Because we were right in a particularly hot space, and because,

particularly the pedigree of my co-founder having been involved in a, a billion-dollar company start-up in the past, gave us a great, great capability. So, really exciting times, exciting...

#### Seventeen patents.

Yes.

#### Huge amount of intellectual property.

Yes.

#### Why did you sell?

[laughs] It all came to nowt. So, so actually, what came back to bite us was my, my slightly premature departure from Ofcom without having fixed the TV white space problem. Because this all contingent on getting access to this white space spectrum. And, when I left Ofcom I thought that I essentially, had left it in a position where it was imminent. And, because of various reasons including risk aversion, it just didn't happen. Finally did about five years later, but that was far too long. And so the problem was, the venture capital companies that were funding us could see that, we had promised that this regulatory change would happen, and it wasn't happening, and it wasn't happening. And in the end, they said, 'Look, we just can't keep throwing money at this problem. You know, you, you're out of time. You need to, to re-purpose, and sell the company essentially.' And so they brought in a new CEO to, to do that, who was the character to do that, but that wasn't the company I wanted to be in, the company that was now just being repurposed for sale. So I left at that point in time.

#### Did you have shares in it when it was sold?

Yes. But sadly, those shares had been enormously devalued. So, it's one thing I, I've learnt about this. I think when the company was founded I had two per cent of the company or something. When the new CEO came in, he basically did a bit of share

engineering, which dropped my, my account by 1,000-fold, so I went from having two per cent to 0.002 per cent. So when the company was finally sold, I got a, a new pair of speakers for my hi-fi, which is fine, but it wasn't a life-changing experience. And that's one thing I've learnt is, you can have a, a share of a company which looks great, but overnight it can turn into nothing.

#### I'm sorry to smile.

[laughs] No. And I didn't mind. Actually to be fair, I was absolutely not doing this for, for the financial reward. That would have been lovely, I mean I would have taken it, and I would have, I would have spent it, but, but it was the interesting problem, the interesting challenge that, that I particularly liked about it.

[55:18] So Neul was sold in 2014.

Yes.

#### To no other company but, Huawei.

Yes. So I, I'm glad I had left before then, not because, not because I share all of the current concerns about Huawei, but, first of all I don't think it's a company I'd like to work for, at all, large companies, and particularly Chinese, would not have gone down well with me, but also, I think it might well of reduced the number of potential things I could be doing now if I had a, a Huawei stamp on my passport. Which is a sad thing to say, but I think it's nevertheless a reflection of where we've got to at this point in time with, with Chinese companies.

#### Should Huawei be allowed into the mobile network of the UK?

I think that, the security concerns are, are overdone. I think there's a different question about Huawei, and that is a more general Chinese question. Chinese companies often don't play by the same financial rules as, as the West. State aid, other kinds of things like that. And effective intellectual property. I mean these are well-known problems with, with Chinese companies. And, I think one of the, the reasons Huawei has grown so big so quickly and done so well is because it's had a number of advantages if you like because of those kind of factors. Which has meant it's not playing on a level playing field with Western companies. And then we've seen many go out of business, and, we get to the state we're in today. So it feels to me like there's a valid reason to say, if you're going to compete with these companies in our country, you need to compete on a level playing field, in many ways the Brexit negotiations kind of, differently. So I think it's quite fair to say, we are going to, to pay some kind of penalty on Huawei for financial competition purposes. What's actually been done is, that's been dressed up I think as a security concern, because that's an easier thing to, to dress it up as. And I think those, those fears are, are overdone. Because there's ways around that even if you weren't worried about that. But we are where we are, and, I don't suppose that, that's going to change much in the, in the next few years.

#### [57:29]

There's a model of people's careers is that, they do, and then they manage.

#### Mm.

And you've had to manage people, particularly at Ofcom.

#### Yes.

You had a team of 35. At Neul you had people to manage. William Webb, what are you like as a manager?

[laughs] I only like to manage really competent people. So, so I think I would be... And people who think like I do. So broadly, engineering types. I think I'm pretty good as manager of those kind of people, because I'm prepared to give them a fair amount of flexibility, and, because I think I can gel in my way of thinking with those people. So, so that tends to work well, and by and large, the people I've managed have kept in touch every year, we've stayed good friend. I think I would be a terrible manager of people who are not engineering types. I just don't think I've got the, the social skills to do that particularly well. And I've never really done that, and I never wanted to, to do that. But I, I don't desire management of people. I think it's one of those things, if it's useful as part of the, the problem resolving, then that's great, but I'm equally happy just to be solving problems without that particular challenge. And I don't manage anyone now, so it's not something that I've been trying to, to build during my career.

#### Can you fire people?

[hesitates] Yes, I can. I... I'm not psychopathic almost, I'm not prepared to do it just because somebody says to me, 'You must fire,' somebody. I'd have to, have to truly believe that it was in the best interests of the company and probably that person in order to, to go ahead and do it. But I have, you know, I certainly made, at Ofcom I made, was it 25 people redundant, and that wasn't quite firing, because that's a, it's a less personal process, but I certainly went through that process because I felt it was the right thing to do and in the best interests of, of everyone concerned.

#### [59:31]

#### Did you have a mentor, or mentors?

Yeah. Quite a few actually. So, probably the most, the clearest one was, was Professor Raymond Steele, the, the professor I talked about whose company I joined early on. He was a maverick, but he was an interesting character, and, definitely somebody who was, was really useful, and he was, he taught me a number of things such as, he was great at writing, so he taught me how to write much better than I would have otherwise been able to do. He kind of taught me about the blend of different skills and disciplines and things like that. So, he was, was hugely valuable. But then I've had quite a few during my time. Another one that stands out is Sir David Brown, who was Chairman of Motorola in the UK. Although that wasn't where I met him actually. He was very influential in the IET and was President many year before I was, but, but I was kind of, in that process during that time, and, you know, got an awful lot of guidance from him over the years. So, yeah, absolutely, definitely. And when I look back I think to myself that it's, that's, the mentors have probably been the most influential thing of all on my career. [1:00:49]You were President of the IET from 2014 to 2015.

Mm.

Forgive me, but you don't look like a very Establishment person.

[laughs] No.

I don't mean physically looking, I mean, your career doesn't look Establishment.

No. And you know, it's an interesting question, why did I do that? Why did I go down that, that particular route? And, I drifted into the IET early on because, I was sort of half in the academic world when I started doing my PhD, the IET, at the time it was the IEE, was the place where you went and presented your academic work at some of the conferences and so on. I sort of got interested in how those worked, and, and how the publications around those worked, and decided I would get involved in that. So I kind of, entered into the, the IEE, the IET, through a kind of natural academic kind of role. And then when I was there, I don't know, to some degree I was noticed, and headhunted. So actually, I was asked, would I like to join the Publications Board, and then, I was asked, would I like to join the Main Board. So, those are all things I hadn't planned to do. And, and it hadn't even crossed my mind in fact that it would be worth doing. And, I, in both cases suggest, I was interested and, you know, very keen to do that.

But you are a Fellow of the IET.

Yes.

And you are a Fellow of the IEEE.

Yes.

#### So you are a bit of a joiner.

Yes. [laughs] Yeah. And, I think in all those cases, so the, the IET is something that you joined, at the time when I graduated you joined it, it was your professional institute. There wasn't really a question about it, you just did it, it was part of the process. The IEEE, less obviously so. It's the American equivalent. But, given that I wanted to move out to America, there was some sort of sense there. But I think, once I was on the board of the IET, I became quite interested in, what are these institutions for? And, why are they still alive? What are we doing with them? And that became quite an interesting kind of problem, challenge. Could they be turned into something, changed and moved into something that, that was more useful, more interesting, more fit for, for purpose? And I found I enjoyed that whole kind of proses of questions. So I think, you're right, I, I'm not a natural, naturally obvious kind of person to do that, but it just sort of happened.

#### You don't look like a committee person.

#### [laughs] No.

But tell me, answer this question then. Can they be moved into something more useful?

I think so. So, when I, when I started on my process for, board and then Vice-President and then Deputy President, President, at the IET, I would say it was predominantly an old boys' club. Now, perhaps it's a nasty caricature, but essentially, it was seen by the members as something that was beneficial to them. So its purpose was member benefit. And, the problem was that, the benefits were declining in importance. So, as the Internet was becoming more prevalent, you didn't need the IET as a source of information. There were plenty of other conferences to go to, you didn't need the IET as a, a conference venue. You didn't need this building in London, because you could go to Starbucks. You know, the whole of the, the rationale of, why be a member for those kind of things, was falling away. As was the need to be chartered. So, it's still very prevalent in some engineering disciplines, particularly where there's safety of life considerations, but, for most electronic engineers, most of them aren't working on safety of life issues. If your iPhone doesn't work, it's a bit of a shame, but, you're unlikely to die as a result. So, the need to be chartered, to tick that box that says, this person is competent to do this kind of work, had fallen away. So all of that started to disappear. But it seemed to me that there was a whole rationale around societal benefits from having a strong engineering voice that were really important. So making sure that politicians, senior civil servants, got a good engineering input to a number of the challenges that they had, or questions that they were facing, was really important. And because engineers generally don't go on to become politicians, because they're too introverted, it meant that otherwise there was, there wasn't a particularly strong voice. So, so I tried to reorientate the IET more towards a, we're doing this for the, because, it's important for society, and you join the IET if you believe that you want to make a difference to society through engineering, not because of personal benefit. Now hopefully if you volunteer and do this sort of stuff, you'll find there are all sorts of personal benefits that accrue from it, the serendipity of meeting other people and so on and so forth. But, it's not about member benefit, it's about making the world a, engineering a better world I think is the catchphrase. So I think that, that can be done. But, you know, these are venerable institutions, 150 years old or so. You don't change them around in one year. But you can, you can move the dial a little.

#### [1:05:54]

While you were... You helped establish, in fact I think you established it really didn't you, the Weightless SIG.

Mm. Yes.

Special Interest Group.

Yes.

#### What is Weightless?

So Weightless was the technology that we came up with at Neul. So I mentioned earlier that, the whole, the whole idea of Neul was to come up with a new wireless technology that would allow these Internet of Things devices to talk to each other. And what we, what we realised very quickly was, that, in the world of wireless communications, the only things that are successful are standards. So if you think about all the, the wireless systems that we use, Bluetooth and Wi-Fi and cellular and radio, all these other kind of things, they're all open standards. There are no systems that are just from one company. Because, it just wouldn't work, you know, it would be too monopolistic. So, I said, well, you know, we've come up with this new technology, but it has to be a standard. We can't just have it as Neul's technology. We'll sell some, but, frankly, it's never going to change the world. So, we, we looked at what Bluetooth had done, which was to set up a new standards body, and in fact it was called the SIC, Special Interest Group, and that's where we took the same name from essentially, we branded ourselves as, the Bluetooth equivalent, we're going to do again what Bluetooth did. And I set up a standards body, which you can do, you don't, you know, it's, like setting up a company in a way. And, aimed to, to grow that and deliver something. And for a while it was, it was all very promising. We grew a lot of members, a lot of interest, a lot of people contributed, we wrote standards, we published standards. And our outputs were going very well. But once Neul had got its new CEO and its direction changed, then it was progressively harder to, to make headway. I think the longer people looked, saw that the key company behind it all appeared to have lost interest, and that, that was rather telling. We actually kept it alive, I kept it alive, for another, six years. It's one of those things where, it didn't take much effort to keep it alive, and there seemed to be a potential it might just do something, but it never quite did in the end, which, which I still feel is one of the biggest disappointments for me actually, that, we don't yet have a good way of connecting Internet of Things devices. We're still nowhere, nothing, nowhere near the situation that was envisaged back in 2010, where pretty much everything would be connected by now. And a lot of that is down to, to lacking in good radio standard. Weightless could do that, but, it never quite got the, the political backing or the backing from the key companies that was enough to move it over the edge, you know. It's another thing I learnt lessons about was, the need to have the backing of a number of big players, the Googles, the Apples and so on. Even if they do nothing, you need to have their name to persuade others to take this leap of faith.

When I saw the papers that are still around about Weightless SIG, because they're still on the Web and so on, I saw that this dedication was to the Internet of Things, and also, a second acronym, M2M, machine to machine.

Yes.

And that rang a bell with me, and I said, hold on a minute, I remember being in MIT Media Labs in 1995, and hearing about Things That Think.

Yeah yeah.

This is an awful long time coming.

Oh yeah.

And when I see the terminology change, but nothing much happens, I say, here's a crisis going on.

Yeah. I mean, so, absolutely. I think, there's rarely something new on really, is there? So most things have been thought about a long time before. And indeed, you can go back to the 1960s and a system called SCADA, which was a way of linking to a remote reservoir, and checking the water level and so on, which is, which is an early example of the Internet of Things. So, so none of this is, is any way new, and it's been around, stuff has been connected, for, 60 years now. But you're right, it is not working out the way that we thought it would. And, in fact I'm just finishing a book now on, on why that is, and what, what the lessons of the last ten years have taught us.

Do tell.

And it's all basically economics. So back to, back... Also, we've got the technology, we could use Weightless, or, or other technologies. Not a, not a problem. It's, it's actually, getting a viable value change, to use one of those management buzzwords, where everybody in, in the chain can earn enough money to make it worth their doing stuff. And that chain... So that's been quite complicated. So for mobile phones it's

fairly easy, you make a phone, you sell it in the high street, somebody buys it, uses it, and job done. If you take the connected cow, it's quite, it's a lot more difficult. You can't expect the cow to turn up at the shop and buy a sensor, so the farmer's got to make a decision that it's worth him buying all these sensors. But then, what are the sensors going to do alone? That's not enough. He's got to have a program on his PC that monitors everything, and that's got to deliver something useful to him, like, telling him where he can change his food yields or whatever. So there's got to be some sense behind it, some, some expertise in that particular space. All that lot's got to be made to work, the farmer's got to be convinced, got to be sold this system. There's a lot of people in that chain, and making all that work for everyone is perfectly feasible, but actually quite complicated, and, we just haven't yet got to a situation where the companies involved in this process are oriented correctly to be able to do that. And you can see what companies you would need, and you can see where differences reside from the ones you've currently got, but getting from A to B is a very very difficult challenge.

#### [1:11:49]

MIT's Media Labs now says, 'The goal of the Things That Think Consortium,' the creative consortium...

#### Mm.

... 'is to invent the future of digitally augmented objects and environments.' That's true isn't it?

#### Yes.

One of their, apparently 'fresh frontiers of research', they now said, is, 'Where are the "killer applications" quote marks, 'of augmented objects and environments that will significantly impact and enrich our business and home lives?' Where are they?

[exhales] I think that actually we should start with simple productivity stuff. Sounds really dull and boring, but you know, back to the connected cow. So, what would you connect your cow for? Well, you might improve his milk yield by one or two per

cent. But if, if the tags don't cost very much, then, they could pay back for themselves within a year or two. You could do that with a manufacturing plant and it could make boilers at two per cent cost savings or something like that. None of this stuff is very exciting, but actually, you know, it's, it's productivity improvements, it improves everyone's lives a little bit. And, it's, it's relatively easy to justify. If you can say, 'Look, if I spend £100,000 on this, I'm going to get payback within eighteen months and then within five years I've made lots of money,' that's so much simpler than saying, 'This is going to be transformative.' Because, transformative stuff rarely works out the way you expect it to, and so it's very very hard to justify from a business point of view how to do that. And so, I think we need to just back off a bit and say, let's, let's just do the simple stuff, get that working well, and then, from there we'll, we'll see how, how things might change in the bigger world.

[1:13:51]
When is your book out?

I'm hoping it might come out in the next couple of months.

And what's it called?

I'm trying to remember what I called it now. [laughs] And, I.....].

Forgettable moments.

[laughs] Yeah.

And who's the publisher?

So I'm... I'm going to publish it myself actually.

Very good.

In fact I'm co-authoring it, but, I've discovered that self-publishing, which is what I did for my, my last two books, is much faster, more flexible, and, more lucrative than the, than going through conventional publishers. So...

And you just print on demand.

You do. Which is pretty amazing actually. Yeah. Another way that the world has changed significantly.

[1:14:14]Eight years ago you established Webb Research.

Mm.

Which is basically, a consultancy.

Yes.

And do you employ people?

No.

It's you?

Yeah. I, I mean, I sometimes add subcontractors in to particular projects, but I don't have full-time employees. I decided I didn't want that, I didn't want the, the management overhead of looking after other people.

#### That's fine

And also, the world of consultancy, at least, at least in my area, telecoms, is changing, to much more what's called an associate model. So yes, sure, there are still the big companies, but an awful lot of work is done by a collection of individuals coming together for a particular project, because that blend of individuals is just the right

answer for that. And then, fragmenting and working differently and then changing and coming together again. And that clearly makes sense from an efficiency point of view, because you don't end up employing lots of people whose skills are only needed periodically. It does mean a very different way of working, you don't then expect a monthly salary. Instead it's much more, you're on your own trying to, to find work for your business. But it, I think, you know, it works well for me, I think it's an interesting new model.

And also, each client gets access directly to the CEO.

Yes. [laughs] Whether they like it or not.

#### [1:15:32]

You've got a number of projects in your career history here that sound pretty interesting, and I'd like us to, of course without you revealing too much, because you have, I'm sure you have clauses in your contracts...

[laughs] Sometimes.

...that you've had to sign...

#### Yeah.

...which, you don't talk about this. Work for a UK telecoms operator that had become unprofitable, helping them to reduce costs and to separate their national from local business, in order to spin it out. Who was that?

So that's one I can't actually tell you about. That's, that's still ongoing actually, or, just about to finish.

#### How did you solve their problem?

To, to encourage them to take a long hard look at what it was they really wanted to do. So, in a way it was, it's a bit like the dotcom bubble, they, they had seen lots of

other telecoms companies apparently grow big, do great things. CEOs typically have grandiose views about where they'd like to go. And, and so, it was kind of, we can do the same, we can grow like that. And, to ask them, just take a step back and say, why, you know, where do you expect to see the, the revenue? Why do you think everyone's going for that space? Is that really going to work out? How are you different?

And also, the CEO probably thinks, why can't I be a knight as well?

Yes.

There's a question.

Yes. [laughs] Yeah yeah, absolutely.

There's ego there, isn't there, sometimes.

There's, there's... Absolutely, yeah. And, you know, I see that a lot. And, you know, I, it's, in a way it's, it's just like politicians, you don't get to those kind of positions unless you're very optimistic about the outcome. And, that tends to drive particular behaviours that, that are often too optimistic. And, you know, that's partly why the mobile phone companies paid so much back in 2000, the CEOs were both optimistic about where their companies were going, and they didn't want to be the company that, that didn't have a licence. So, that sort of behaviour I think is, is all too prevalent and just something to, to watch for.

[1:17:37]

Also in the last eight years you've written a major report for Ericsson...

Mhm.

...on the barriers that make mobile network developments more difficult, such as local authority bureaucracy, health-related limits, and lack of international agreements.

Mm. Yeah. So, that one I can talk more about. And you know, I think that's, that's absolutely true. So, for mobile phone companies, one of the biggest costs and difficulties now is putting up new masts. And, you know, quite rightly people don't want them in their backyards and so on. But equally, if there are no new masts, then it's harder to expand coverage. And, that has become such a blocking factor that it's almost impossible now to, to really build better networks. And, governments are aware of this, and there has been change in legislation in the UK and elsewhere, but it never quite goes far enough, and there's often unintended consequences when people just don't think this stuff through, which has led to even more problems, so... One interesting one was, UK Government said, 'I know what, we'll give the mobile phone companies more power over the landlords, so that the landlords can't block them adding more masts to their buildings.' But they gave the phone companies so much power that the landlords actually said, 'You know what, we just can't put up with this. We're going to kick them off altogether. [laughs] And then we'll allow nobody on our buildings.' So, the consequences were actually negative rather than positive.

And as you go up a generation, you have to have smaller and smaller cells, don't you?

You do.

And therefore you have to have multiple, multiple masts.

You have to have more of them. Yeah. And we're just not seeing that ability. And indeed, you know, it sounds, it sounds almost trivial, but, one of the projects I'm currently toying with requires good access to lamp posts, because in fact...

Good access to ...?

Lamp posts.

Lamp posts.

Lamp posts. This has been well-known for, for many years, but in some respects are, are perfect. They're nice tall masts, they're regularly spaced, they've got power already supplied to the foot of them, and you can just bolt stuff to them in principle, then you've got a nice regular grid of, of transmitter systems. So actually, for some applications, sticking stuff on lamp posts would be ideal, and, not too disruptive, as long it's not too big or ugly. But the problem is, lamp posts are owned by local authorities, each of which has got a different policy, or lack of policy, towards them. And it's almost impossibly difficult to, to deal with a local authority who is by and large not interested in selling as such. You know, it's, it's a headache, they've got other problems to resolve. And, Government really could do with centralising all of that, and saying, 'We're going to have a kind of, you know, a UK lamp post selling agency that can ensure this is all easy to do.' But it's not happening for, because it's just not a big enough problem as far as the politicians are concerned. So, you know, those kind of things are actually, vastly more influential in the way that we use mobile radio systems, or, or fixed radio systems in the future, than in fact new antenna systems or chips or anything like that.

#### [1:20:51]

You work very strongly internationally with international, what I would call vendors and users, and network operators. Are you concerned about the future of the likes of Ericsson and Siemens?

[hesitates] Ye- I mean I... Yes. So, Ericsson certainly, Nokia as well, are, are suffering significantly. I... And I see Motorola and others fall apart. So, so in a way it wouldn't surprise me in the least if, if those kind of companies fragmented and failed. You know, back to the Huawei point, that's putting a lot of pressure on, onto those kind of companies. But equally, there are other things, there are other companies emerging doing new and different things. So, I don't think to myself, we must at all costs maintain the Ericssons, the Siemens, the Nokias, but it would be dangerous to, to, for them to, to fall apart too quickly, because they're core to our current network system. So, we had the O2 network failure in December, just over a year ago now, which all added to Ericsson's system failure. If Ericsson hadn't able to, to fix that within a day, the network could be down for weeks. So, we do need to be careful about, about those companies. But I think equally you don't need to maintain them forever.

#### Is Philips, as they would say, out of this space now?

Yeah. Yeah they, I don't think they have any really significant... They have a little bit of smart home stuff, you know, connected light bulbs and things like that, but, but no significant radio communication systems.

#### [1:22:35]

From what you said about the use of M2M technology, or IoT technology, I suppose your short study for Rolls Royce on possible strategies for the deployment of IoT, must have been a delight for you.

[laughs] It was. And, you know, they have interesting problems, so, some of their sensors have to go into engines that run at thousands of degrees centigrade and so on. So, actually, the environment is incredibly harsh. They also have global, global supply chains, obviously their aircraft go all over the world. And, very significant safety ramifications, so, all sorts of, of issues there. So, so yes, it was an interesting environment to, to look at. But actually, it's back to the big company problem in a way, that, they could do a lot more than they do if everybody's prepared to sort of, start and play and do things. But it's kind of, big decisions need to be made and so on and so forth. But yes, that was, that was quite a lot of fun.

[1:23:37]

You also worked as a contractor for the Department for Culture, Media and Sport.

Mm. Yes.

#### Does the Government get it?

No. [laughs] Not at all. And, it was an interesting eighteen months. It was quite frustrating. I expected it to be frustrating, to be fair. And I, and I did it mostly because I thought it would be interesting to, to be immersed in that, and just to, to

learn a bit more about how those kind of departments work. And, you know, what you immediately spot is, that, within DCMS, within the Civil Service part of DCMS, there are very few engineers. And that's not because they don't want engineers; it's just, why would you go and work for DCMS, frankly? If you're any good, go work for Google or Vodafone, you know. The idea of sitting in a government building where you can't even get a free cup of coffee, when you could be off at Goggle with all those wonderful, whatevers, just seems ridiculous. So, you know, it's unsurprising. And then you've got government ministers who typically don't have much background in, in that space, and come and go quite frequently as well. So overall, there's very very little expertise in there. And, if you inject a bit of expertise, like me, then, it's a bit like injecting a, a sort of virus into a, into a machine. [laughs] It's kind of, 'Oh, we're not sure about this. Let's kind of, isolate it and keep it safe before we can really be sure what havoc it might wreak on, on everything we're trying to do.' Which is, you know, fair, I'm not, again I'm not trying to be critical of individuals. I think it's just the very nature of the, the beast. But it does persuade me that actually, you need to be very careful if you're expecting Government to do anything significant in areas where it doesn't have expertise. Now there are some where it, you know, it does or it has to make those decisions, healthcare for example is clearly a, a public service, and you can't just say, 'The Government's not going to have any involvement in healthcare,' that's just, that's just not going to work. But telecoms is an area where it's had very little involvement, so if you suddenly say, 'We're now going to, to require it to do something, we're going to get it to make sure that everyone's got broadband,' or whatever, I think you need to ask then a series of questions, well how are you going to make sure that sensible decisions are made in that way? Because, you don't have the expertise. If you just bring the expertise in, the chances are you won't, you won't utilise it fully. And yeah, you can, you could postulate ways it could work, but I think, the system by and large will, will work against most of those. You know, almost back to Dominic Cummings's recent comments about 'I want mavericks' and so on.

Mm. Mm.

It's... I'm not sure you really want too many mavericks, but there's some, he's got, he's onto something there, that, that, if you want to do things a bit differently, then, you need to, to find some way to inject different kinds of people into the system.

#### [1:26:29]

So since the 4<sup>th</sup> of May 1967, you, Professor William Webb, have seen a tremendous number of developments. Won't all this stop if Moore's law is no longer attainable?

I don't think it will necessarily. So, so I think, already Moore's law is slowing. It's not... The death of Moore's law has been postulated, forever almost, [laughs] almost as long as Moore's law has been around, and, and it hasn't happened. But what I see across, not just Moore's law but many other similar kinds of laws, is, a gentle plateauing. So instead of it growing as quickly as it used to, it's still growing, but at a slower and slower rate. That does mean that we can't look for the same kind of prudence we had in the past. So, in the world of mobile communications for example, until recently we had been able to rely on technical efficiency improvements. So given the same amount of radio spectrum, the same number of radio cells, and all these other kind of things, we've been able to improve the amount of data we can send by, tenfold in some cases, even 50-fold, by making use of improvements in technology. We're pretty much at an end to that now. It's always dangerous to say that, but, but we're getting to a number of fundamental limits, Moore's law. And other things. Even if Moore's law progressed, you would have a handset that would get so hot, you would need to wear, hold it with oven gloves, if they couldn't find some other way of solving the battery problems. So all these things mean that we have to look for different kinds of, of solutions, different kinds of ways ahead. But the innovation we still see I think is, is huge, and to some degree it's, it's now, artificial intelligence and things like that that can effectively do things that, that give the appearance of a lot more intelligence to a device without necessarily requiring a lot more computing power in that device.

[1:28:21]

But in your area of expertise, surely the more important thing is Metcalfe's law.

#### Mm.

Yes?

Yes.

Which is that, if you double the size of a network, you don't just double its value, it goes up exponentially.

Yah. And I think that's, that's right. It's not just... I mean, Metcalfe's law effectively says, the more people you can connect to, the more useful everything is. And I think that's true. But also, there's, there's also just an economies of scale kind of concept as well that underlies a lot of what we do now. And, essentially, that does say that once you've got enough devices out there, that's great. And, and back to the Internet of Things. You know, I think we're struggling to hit those kind of, Metcalfe law scale kind of points that suddenly create a tipping point where, whoosh, off it goes. And that's, that's pretty important. But yes, that absolutely has driven a lot of growth, and... And also, you know, not just growth, but bad things as well to some degree. So, the reason why it's hard to displace Facebook is because Metcalfe's law says, the more people on Facebook, the more useful it is. And once you get to a certain point, it's so useful it's, it's very hard to envisage anyone else being able to compete with it. So, it drives us to, to monopolies as well.

[1:29:37]

Are you fearful about AI and its possible impact?

[laughs] No.

You're not?

I think it's hugely overstated.

OK.

I think AI is massively over-hyped. I think it's, you know, it's, it does some great things. For example, I think it's got really good at language translation. Not perfect, but, you know, astonishingly good frankly. And, that's great. It seems to me that, you need to just, you need to, to split problems into two sorts. One is, closed problems where there is training data and a clear outcome, and learning languages is one of those. The problem is, how do you translate from English to Chinese? There's a whole load of pre-translated books, so you can go learn from those. And you can decide whether your machine-translated outcome is good enough to, to be readable, and you solve that problem. Then there's a whole load of problems that are just, open-ended. You know, how do you solve the Brexit negotiations? And, there's no learning data for those, because it's never been done before. There's no obviously good outcome. AI has got no hope, frankly, of getting anywhere close to that. Which is why I don't think it's going to take over the world. But I think in its, in its place, it can do some really useful stuff. And I think coupled to the Internet of Things, you know, for example, AI could help you work out how to, to optimise your farm system to, to maximise productivity and growth on that, that could be really valuable. That's not going to, to upset what humans do and humans don't do. So, so I'm not concerned about the singularities and, and machines suddenly becoming so clever they take over the world. I think I'm probably more concerned about just, being too optimistic about AI and what it might do.

#### But Dominic Cummings doesn't, thinks we don't need agriculture anyway.

[laughs] No.

#### [1:31:25] We'll move beyond that. What are the biggest mistakes you've made in your career?

Mm. [pause] Certainly, if I look back at the whole Neul, Weightless, IoT thing, that's, that has not played out the way I had, I had hoped. And, that's my biggest disappointment I guess. I would have loved to be able to sit here today and say, I was part of connecting all these machines, and the fact that stuff happens nicely around us is, yeah, is inherent to that. And that's, that wasn't one single mistake. That was a whole combination of misjudgements I think, through that. So that, that's probably

the, the biggest. Other than that? I'm not sure there's any one... I, I guess I'd characterise my, my career as a series of, small errors that I learnt from. [laughs] Of course correct, and, and help in a slightly different direction, and hope for the best. And so, I could probably point to hundreds and hundreds of relatively small mistakes. I can't think of many, of anything I really regret and look back and think, you know, that was a complete, a complete disaster.

#### [1:32:39]

As an engineer, you learn from your mistakes, it sounds to me.

I think that's, that's right. I think, it's, it's important to be able to own up to them even if it's just to yourself. It's important to, to look back and say, oh, you know, I said that a few years ago; it didn't play out the way I thought it was going to play out. Why is that? And it's important not to just assume that that was somebody else's fault. [laughs] You need to take some responsibility, even if the reason it didn't play out was because, Mr X didn't do what you wanted him to do. You should have understood that that was always a possibility. So I, I do like to, to effectively make forward prediction, quite specific predictions, either in a published book, or, or effectively implicitly because I'm saying and I'm going to bet on this particular technology, or try and do this. And then, at some point say, OK, well that didn't quite work out as planned. Why didn't that work out as planned? What have I learnt from that? And how can I add that into, to the future?

#### [1:33:43]

You alluded to the fact that, there perhaps was a little falling-out with colleagues at the University of Surrey.

Yes.

#### What was that over?

So... So the University of Surrey was hugely successful in gaining a lot of funding for 5G research. And, you know, hats off to them, it was an amazing achievement, from the lead professor there, Rahim Tafazolli, he managed to pull together, herd a

whole load of cat] frankly to get a number of large players to fund a whole new building, a whole new research establishment around 5G. So from a, from a managerial point of view, that was a stunning success. I just didn't think 5G was worth it, and indeed that 5G was anything more than a minor enhancement on 4G. And it was hugely over-hyped. And I got so frustrated by all this 5G hype, not just from Surrey at all, but, but more broadly. In the end I decided that, it was time to, to say something. Which, from a career point of view was stupid, potentially stupid, very risky anyway, but from a personal sanity point of view, I just couldn't bear not to, to do it. So I wrote a book called *The 5G Myth*, which basically said, this is hugely over-hyped. Of course that didn't, wasn't very helpful to Surrey. [laughs] And, having me associated to Surrey as Visiting Professor, and the professor that said, 5G is not a good thing, or at least, it's not, not as good a thing as, as you are making out, was clearly, really not very helpful. And, and so, when my visiting professorship ran its course, it was quietly not renewed. And, and I'm not in any way bitter. I mean I, I would have done exactly the same in their position around that. And certainly, the team there were, were pretty unimpressed by, by what I did. But, it was just something at the time I felt needed to be done. And I still think it's correct. I still think it's, it's massively over-hyped, and I think it will cause a significant number of issues for telecoms companies in the coming few years actually.

#### [1:35:56]

Normally we're very optimistic about the development of information technology.

#### Mm.

You're a very realistic man...

#### Mm.

...and you have what is called in the business, forward spin. Your ability to analyse the future and see where things are going has made a great contribution to the archives today. Thank you very much Professor William Webb.

You're very welcome, I've enjoyed it a lot.

[End of Interview]