Richard Hopkins

Interviewed by

Richard Sharpe

23rd July 2023

By Zoom

Welcome to the Archives of Information Technology where we capture the past and inspire the future. It is Tuesday, 23rd July 2023. My name's Richard Sharpe and I've been covering and writing about and analysing, first of all, the computer side and then the full IT side of this technology since the early 1970s. And helpfully, today, we've got another Richard, so there'll be no tangoing, forgetting of names. It's Richard Hopkins. Richard Hopkins has a most distinguished background in engineering - as I think he would like to call it – others may not call it that. He is at the moment a distinguished engineer with IBM. He has been, his IT career is entirely with IBM and he has the prestigious position of being the President of the IBM Academy of Technology for two years or so, and that is a meeting place of over 700, I believe, technologists of huge calibre, and we've seen many of them in the Archives so far, from IBM. In my opinion, and it's only mine, and probably Richard's as well, IBM doesn't get enough credit for its technology. People like Gates go on about how wonderful they are in innovation, well, no, in my opinion again, not particularly good, and I remember the man who formed Oracle saying, what? Microsoft, innovation? You must be joking, look at IBM. The relational database, things, the disk drive, etc, etc. And IBM ploughs on. Richard was born on 2nd May 1969, a very important year, because Unix came out, the ubiquitous operating system with its ubiquitous and horrible programming language of C, and also IBM unbundled, which meant that it now sold its software separately from its hardware. You got hardware you bought, or rented – rented actually – and then you had to take their software, by unbundling IBM not only created another revenue stream for itself, but also created an enormous area for other companies to come in and write software for IBM machines, which they did in very large numbers. Yet IBM remained as well a very strong leader in software. Richard, your father, and your father's father were both engineers. It runs in the family.

[laughs] It does, and I'm delighted to announce that my son just graduated with a mechanical engineering degree. So there you go, it keeps on going. At least down the male line anyway.

Right. You consider yourself a software engineer, do you?

Partially, yes. I mean mostly, I guess, these days, yeah. I've been involved in all different kinds of aspects of the IT industry, because IBM is involved in all kinds of different areas, but the thing that has kept me engaged, most engaged, I guess, has been the development of large-scale complex IT systems for IBM's clients, which means – and that's always a fusion of software and hardware - but obviously the creative element tends to be on the software side of things, or possibly sometimes in research and I have done some things that have involved, you know, innovative stuff on the physical side as well, but mostly software, yeah.

Okay. Now, you were born up in Newcastle-upon-Tyne and you live quite close to that area still, don't you?

Yeah, I believe my life is generally one of huge elements of serendipity and being born in Newcastle was probably *the* most serendipitous thing I could have done, because basically I was over two months premature, yeah, which back in the 1960s was very premature indeed. There wasn't the drugs or the SCBU units and skills we have today that make, you know, my own daughters were born prematurely as well, we were never concerned about their safety. But back in the sixties, being born at that kind of level of prematurity, generally speaking, you didn't tend to survive. But my mother was on a shopping trip with her sister, who lived in Newcastle, which was one of the very few premature baby units in the country at that stage. So unbelievably, I was born in Newcastle, which just happened to be where the premature baby unit was placed, and I stayed in hospital for a few months after being born. Had I been born at home in Teesside, where I currently live, I wouldn't have survived.

[00:05:10]

You were eager to see the world, Richard.

I was clearly incredibly impatient and continued to be so. And also determined, I guess, is the other element of that. You know, you've got to be fairly determined to survive in those kind of days. It was a, it was kind of a, I think the odds that were given, even though I was in that unit, the odds were still about fifty-fifty.

Your father was a marine engineer.

He was, and an iconoclastic one at that. So he used to delight in telling me stories about how he would be given edicts from on high by Shell high command in London about how to maintain his oil tanker and what to do with it and, you know, what best practice was, which he would then run roughshod over and find new ways of doing things and better ways of doing things and ways things would last twice as long, which would then of course result in the best practices being rewritten. So, yeah, I… and my grandfather before that was not dissimilar. So, yeah, a line of, not just a line of engineers, but a line of rule-breaking engineers, I suspect.

[laughs] Argumentative Geordies, is this it?

This is, well, I mean that side of the family is Welsh, so even possibly worse than argumentative Geordies, argumentative Welshmen. So yeah, my father… my grandfather moved up from the kind of Merthyr Tydfil area, you know, where he was in charge of the powerplants and things down there. I won't go into the digression, but basically he moved up to ICI near Billingham in the north-east, and was responsible for creating the power grid around all the major plants that were obviously there at ICI at the time, which was probably, I mean it's still today one of the backbone elements if you look at the national grid, you can see the stuff that goes to Teesside – woefully underused these days, I suspect – but my grandfather designed the ICI side of the that element. So yeah, so my father moved up to the north-east, I think when he was about five or… about five, yeah, and he still has a Welsh accent, which is, I still find a little extraordinary, but there you go, stubborn Welshman, I think.

Well, I should have guessed that, Hopkins really, yeah.

Hopkins, yeah, well there you go. Yeah, yeah, exactly.

You went to a primary school, a state-maintained primary school for six years, you started there when Ingres, the relational database was launched, and Intel's 8080 microprocessor, again, important time. It was a good school, was it?

I loved it, yeah, I absolutely adored it. It was… it encouraged across the board, you know, I mean whether you were sporty, whether you were arty, whether you were science-y, it was equally enthusiastic about all elements, which suited me well – well, I wasn't the sports thing, obviously - suited me down to the ground, and encouraged the interplay between arts and science as well at that stage, which I didn't realise was so unusual until I came, you know, got into secondary schools and beyond, and woe betide me when I went to university, you know. I still think, actually, that was a better educational environment than any one I've been to since. [laughs]

Right. And that's, why is the merging of those cultures so important?

Because it, well, it certainly helps me think. You know, I resist very strongly this idea that there are different fields of subject and study that you must, you know, follow if you are a scientist or an artist. You know, I believe in following both pretty equally, as much as I can, because I genuinely think the thought processes you need to go through to come up with new ideas and new ways of doing things, or even to do simple things like empathise with an end user requires you to develop both sides of your brain and the creativity is bringing those elements together. So, you know, I've always been frustrated and resisted quite strongly this, you know, hard line between the arts and the sciences.

[00:09:50]

It was very hard in my secondary school as well, just no way, no way.

Well, the timetables. I mean, you know, engineer the timetable so you can't, you know – we'll come to it later – but, you know, I have frequently had timetables had to be reorganised around me.

Yes, my mother managed to get that through, only though for advanced… not advanced level. What's the one between O and A? A/O, isn't it, something?

A/O level, yeah, yeah.

In maths, otherwise no, can't do it, you can't do A level maths and English and history, oh no, no, not possible.

Definitely not, no.

But you went to a secondary school which is very different than the normal one. Tell me about it.

Yeah, so this was, I mean if there's such a thing as a start-up public school, or private school they would have called it, this was it, okay? So, basically there was a very well-established private school in the area for all the ICI employees, for them to send their girls to. But there was actually – and in those days obviously education tended to be, private school education tended to be segregated – and of course my parents looked around and went, and where's the equivalent for boys? Well, there wasn't one. And at that stage my father was very adamant that, you know, there should be the ability to have a good science education background. And although the schools around us are actually exceptional schools, and they continue to be, the state schools, in those days both the major state schools that were in the catchment area were both very arts-oriented and there was no science stronghold, if you like. Which is bizarre when you think about it, you're talking about an environment which at that stage was almost entirely manufacturing and engineering, and there was no kind of really successful secondary school in the major catchment area for the people who were, you know, probably the middle management or the senior management of those places. So it was kind of like, mm, alright, well, let's start our own school, because, as you do. So, you know, there was a core group of about five parents, and I think my parents formed the next ring out of another core of about ten or 15 parents, who essentially then started a school. Found a headmaster, found a site and literally started a school. To say, you know, we were involved in it is a slight understatement, I was still at primary school when I found myself painting the chemistry walls, chemistry lab walls of the old grammar school that we were taking over. So I was, you know, even at primary school I was, well, child labour, there you go, but, you know, helping build the school. And then on the day that the school actually opened, the boiler didn't work, so, you know, the headmaster knowing that my father was a marine

engineer and knew all about boilers, phoned my dad up and got him out to fix the boiler for the school on the day that it opened, you know. So just a very, not what you'd expect from a private school, you know, very make do, very, you know, how can we engineer this, very, the kids need to muck in otherwise the school will fall apart, kind of place. It's now a massively huge successful school that's got, you know, over a, I think it's probably got over a thousand pupils in it, it now extends all, you know, it is now probably one of the great glories of the education system in, well, education system of, you know, one of the best schools in the north-east. It wasn't when I was there, you know, we were building it bit by bit, or wall by wall, you know. So it's sad that it's changed its character quite a lot since then, but it was very eccentric. Partially military, partially adventuring, partially driven by the minds of the most eccentric of the teachers, you know. So it had all the, you know, it had a bit of everything really. It was a very good secondary school from that point of view because it was quite malleable in terms of what you were able to get away with.

[00:14:32]

You're an only child?

I am, yes.

How does that affect you?

Oh well, at the moment it affects me quite a lot because my parents both are developing dementia. So that puts me in the role of primary carer. During my upbringing it meant the home was a little bit quiet, I guess, that was it. But, you know, a lot of the stuff that me and my friends did was building things out of Lego or constructing, you know, various different things, I, from the age of about seven onwards, I used to try and build robots and this kind of thing, just using what was around. You know, so I had a lot of relatively solitary hobbies, I guess, but I shared those solitary hobbies with a whole bunch of friends who had very similar hobbies. So that was, so that was kind of okay. You know, I mean I did think it would be nice to have a brother and sister at some point, and continue to do so, but- especially as I've, you know, we've got three kids, we can see what they get out of having brothers

and sisters and, yeah, that's a shame that I didn't have it, but hey, you know, wasn't to be and, you know, and I hope that the worst elements of being an only child have been gently knocked off me as I've gone through my life. I like to think they have anyway.

And in this rather unusual school – I'll not call it abnormal, I'll just call it unusual – you were allowed to do English, maths, physics and general studies at A level?

Yes. Yes, which was a bit of, I mean I was always trying to get art at A level in there as well, but they didn't let me. Well, it just didn't fit because basically there wasn't an arts, there wasn't an A level arts teacher so to do arts I'd have had to have gone to the local girls' school, the one that we were talking about earlier, and that was just too complicated to fit in the timeframe. So yes, so I did those subjects, I got away with it, that required the timetable changing. I was also doing the S level maths and S level English as well, so that caused even more complications with the timetable, but overall they were pretty amenable to it. There was the basic assumption this English thing was just a fad that I'd grow out of and I'd go to university and grow up and do physics or maths or something, at least that was what my parents assumed. As it turned out it was going to be quite different.

Can you remember what you studied in English?

Yeah. Oh… we had the most eccentric of English teachers, he was absolutely adorable, I mean absolutely brilliant. You know, *Good Will Hunting* had nothing – is that the Robbie Williams film? I can't remember, but anyway, whatever it is. You know, he was one of those kind of teachers that genuinely inspired and did all kinds of terrible things, like he showed us… he adored Ridley Scott as a film director, so he would show us Ridley Scott films and he would start with things like, you know, this was when we're at 15 or so, and of course he started with *The Duellists*, which is Ridley Scott's first film, brilliant film. And then blithely worked his way through to *Alien*, which of course was an 18. So you're in a private school being shown *Alien* by your teachers. You know, he was a little bit off the rails in that regard. And the one that strikes me from A level that I do remember very clearly was *Childe Harold's Pilgrimage*, alright? Which is not one of Byron's finest works, in my opinion. It does bloody go on a bit. And the syllabus required us to focus in on certain cantos

and this kind of thing, apart from our English teacher had not clearly or carefully read the syllabus and continued to complain all the way through the lessons during the term, with huge amounts of homework at the end of every lesson, that it was bizarre that they'd given us the entire poem to actually study and learn and focus on. Only after we'd got through the entire poem did he go back and look at the syllabus as he was writing his complaints letter to the board or whatever, did he notice that actually it was only meant to be two of the cantos out of the 13 or whatever. So we had literally studied in class and at home the whole poem, which we didn't need to do, at all. You know, so he was, yeah, he was a little bit off the rails but I, you know, one of those inspiring teachers that you just think, you know, good on you. You know, I am sure he had a lasting impact on many pupils.

[00:19:41]

And you enjoyed your maths and your physics?

I did actually. Maths a little less so. Maths, I enjoyed A level maths. The S level maths I found tricky because there wasn't time, again, in the timetable to do further maths. So I was in this group where everybody apart from me and my mate was doing further maths as one of their main subjects. So we were sitting there going, what are they talking about? In theory you can do S level maths without doing further maths, in practice I don't think you can. You know, or you certainly couldn't back then. So that was difficult, I mean that was genuinely quite hard, you know, because you did feel you were missing out on half the information required to do the, to come up with the answers to the questions. So that took a little bit of the edge off maths, you know, was… I really enjoyed A level maths, but the S level, didn't quite get the hang of that. But physics I adored and continued to adore. You know, I was the pain in the backside of the physics teacher who, you know, who wasn't the best physics teacher in the world, and I would be the person who was explaining it to my mate, you know, what he'd actually just said and how to do it properly and, you know, all that kind of stuff. So I used to get in trouble for doing that. I'm sure I brought his grades up higher than they would have been otherwise. And I was also the one that was reading *New Scientist* and therefore would go, hang on a minute, you know, isn't that not true though, because don't you have to allow for relativity in that and then

that will change that and then, you know. And of course he would have to slap me down and say, no, that's not the case. Or… and unfortunately, that's what he used to do. He didn't say, yes, you're right, this is just an approximation because for A level we work in these approximations, he would slap me down and say I was wrong, and I was going, well, I'm fairly certain I'm right. And that annoyed me, but I still loved the subject, because I just thought, you know, any exam where you can go in at the end of the year – and I still remember it to this day – was, well, I think the exam question was, there was a cylinder of metal sitting on the surface of a neutron star, yeah, to what thickness will the cylinder be crushed. [laughs] And what percentage of the surface of the neutron star will it cover. It's like, really? You know, we actually know how to answer that question. And of course, yeah, if you applied enough of the different techniques we'd been taught over the year in a reasonably imaginative way, you'd get to the answer. And it was like, that's cool, I like the fact I can work that out. So that was, yeah, physics always, you know, I went to university with the fullest intent of doing both English and physics.

You say that it was a military discipline, was there a cadet corps?

It was worse than that. [laughs] Every Monday morning the entire school would have, not an assembly, but would have a parade. So literally you would be organised according to your forms, you'd be all in a line, you'd have to, you know, stand at ease, stand attention, all that kind of stuff. And the horror of that just continued as you progressed through the school, so by the time you came to sixth form, you were the person taking that parade. So you would have to shout at the top of your voice, 'School, 'shun', 'Stand at ease!', 'Carry on'. And role calls and everything else. I mean it was just extraordinary. The actual school uniform, rather than being a blazer or anything like that, was actually an army pullover with epaulettes. So you actually were wandering around in essentially what was not that far off military wear, or at least Royal Navy wear. And then the school houses were emblazoned in different colours on your epaulettes and things. It was a bit Harry Potter and a bit kind of military academy, I guess.

[00:24:12]

You went to Durham University but were disappointed because you couldn't carry on physics and maths and English.

Yeah. That was almost the first conversation I had when I got there, was I said, listen, you know, this is a university [laughs], can I do English and physics. And they went, no. [laughs] I went, university? Explain. And they literally, I mean first of all they had to find someone from the other faculty to bring in to explain to me why I was being insane. I mean the problems, you know, they explained the problems as being primarily one of timetabling, and the second one is not knowing which degree to give me. And I think in the end, you know, it would have had to have been two degrees, yeah? And is it turned out, I think, I think I could have got away with it, because on the English course – don't tell anybody – but I went to two lectures in two years, for the last two years of the… I mean I virtually abandoned the formal element of the English course and started my own education. You know, the first year of university's fairly rigid and structured, you have to do certain things, but after that it all gets a bit more easy, so I kind of structured my own learning and did my own things and did a lot of self-teaching and all that kind of stuff. I think, unfortunately again, university's changed, I mean I'm seeing what my kids are going through, much more structured, much more formal, much more you will log in and log out of every lecture, which I do not see the point of. And, you know, and, you know, I think, again, we've rowed even further back from the idea of, you know, it being an institution of learning to being a grades factory in the same way that schools have become grades factories, which I don't agree with, because fundamentally I think we disenfranchise a lot of bright people, you know, through these very rigid, structured ways of doing things.

Had you met a computer by then?

[laughs] Oh yes. So, I mean I was the generation that grew up with ZX81s and Spectrums, so my first, when I saw the ZX80, I just went, I've got to have a ZX80, dad. You know, it's like, please, please, please, please, please, please. You know, I'm allowed to – to give you an idea what – I mean I'm sure you've got this on other

recordings – but at the time, my school had one computer, obviously, which was a Commodore PET. Computer club lessons consisted entirely of writing code, in BASIC, in an exercise book, so that you could try and get the program to work in your head, because there was only one computer so you'd then have to take it in turns typing in to see whether you could actually debug it and get it working or not. Very frustrating, very, you know, not particularly great experience. So the idea of having your own computer, that was extraordinary, and these things, you know, were still expensive but they were affordable now. So the ZX80 I didn't unfortunately get, but they realised I wasn't going to give in, so ZX81 I did get. And I got that for Christmas and I knew I was getting it for Christmas, so when they went out and bought it, because they weren't very good at covering those things up in those days, only children are quite good at sniffing out what's going on really, I said, well, give me the manual. You know, I don't need the computer, just give me the manual and I will read the manual and then at Christmas I'll know how to use it, won't I? And they went, hm, oh okay then. So they relented, gave me the manual, which I then obviously absorbed for the next two or three months. And it was the Christmas, I can't remember which… well, presumably, ZX81, presumably it was Christmas 1981, I don't know, or 1982, was the first year they put *2001: A Space Odyssey* on the TV, I'm pretty certain. It was on BBC1 on Christmas, well, presumably Christmas Day, it must have been, yeah. I seem to remember they put stars across the top, there was all kind of hoo-ha about that, you know, people complaining about them ruining the movie by putting these stars at the bottom of the letterbox things, but anyway. And I thought well, what can I do, you know, I've got this new computer, what can I do with it. So I determined that whilst straight after *2001* was on the telly there was the *9 O'Clock News*, was the next programme, and my grandparents wanted to know what this thing could do, you know, and I was going, well, I'll show you, alright? So I had basically, you know, the span of *2001*, and what I wanted to do and what I succeeded in doing whilst *2001* was on the telly was, I don't know if you remember the BBC News ident from that period? It was basically two lines coming together like this to form the globe, and then BBC News came up at the bottom as a kind of teletype. So I programmed that into the ZX81 whilst watching *2001* so that when the BBC News came up at the end of *2001* I could press 'play', essentially, on my – or 'run' – on my ZX81 and my grandparents just looked on and went… And I didn't get the timings

quite right, because I'd… you know. But basically they saw this thing happen slowly and they just went, o-kay.

[both laughing]

And you could see them just going… they still had no idea what they'd just seen or what had happened, but they, you know, they'd seen this thing do something that was, you know, they'd only seen on the television. And of course, even back then the television idents weren't actually computer generated, they were all animated, they were cel animations, you know. So yeah, it was, yeah, that was my first public program, if you like, of doing that during *2001*.

[00:30:53]

And you took that interest into university as well?

And, yeah. So university, my dad said, well, if you're going to go to university you're going to need a computer, would you like an IBM PC? And I went, no, not really. You know, they were very expensive, I couldn't see what they did beyond what an Amstrad PCW did, because most of what I did was word processing at that stage. So I said, no, no, I'll be doing an English degree – that was after a bit of a fight – I'm doing an English degree, I'll have a, you know, these things are cheaper, they're just as good, they've got really good software on them, I'll have an Amstrad word processor. And then of course when I got to university and started playing around with things there was this operating system called CP/M, which you could boot the thing into, and of course I'd written games on the Spectrum and so I said, oh well, I've got a word processor, what can I do with that. So I did all kinds of things at university with my word processor in CP/M mode. I had stuff published in magazines because I managed to convert some of my Spectrum games across onto the word processor, which was tricky to do, but they all worked. I, what else did I do? Well, in strict linear order, there was that one, the other one I remember particularly well was getting it to write poetry. So I created this kind of weird kind of basically slotting words into stanzas and then associating words in a kind of, these days we'd call it a knowledge graph, I don't think I called it that back then, but basically an element of a

thesaurus combined with extracts from the *Dictionary of Modern Fable* or something. Not *Modern Fable*… doesn't matter. Anyway, so basically I typed in a whole bunch of words and linkages between them and ideas and all that kind of stuff into this word processing and then when you, what you did is you gave it a seed sentence and then it would generate the nearest it could to slot the right words into the thing to give you a poem. So it was a fixed structure, it wasn't particularly sophisticated. I suppose it was for its time. But it wrote two poems. One was based on *Heart of Darkness*, I can't remember what the other one was based on, but it was based on quotes from those two things. So every time you typed in a different quote it would give you a different poem. And after about three or four you would kind of realise it was all coming out, you know, they were all suspiciously similar. But, you know, it wasn't bad for its day. And of course I submitted these two poems to my- one of the courses I was doing was creative criticism, so you'd create something to criticise as a work of art, so those quotes that I typed in were from the work of art that I was supposedly criticising, and then the computer wrote the poems. And then I submitted the poems as my input, without possibly forgetting to mention they were written by a computer. And they came back with A minus and B plus from the professor of English at Durham University. I am to this day absolutely certain the only reason they gave me a degree was because they were terrified of the headlines that would cause, that basically, because the next day I submitted the program along with an explanation of how it worked and the said professor after he'd marked them. So he was aware that he'd just literally given out an A minus and a B plus to a computer written bit of poetry. So I'm sure that's the only reason, because the scandal it would have caused if that had got into the paper would have probably been quite an event in those days.

[00:34:39]

So you actually passed Turing's test of AI, didn't you?

Well, it wasn't close to passing Turing's test, but it was enough, modern poetry is so sufficiently shapeless, formless and syntactically incorrect that even back then a computer was capable of generating something that fooled an English professor. Because, you know, GPT-3 was somewhere off in the distance, this was, you know, people weren't used to the idea that even, that computers could even string relevant

words and slot them into fit slots with, you know, specific, you know, looking at the ends of the words to try and work out whether they rhymed and scanned and number of syllables, you know. These were not things that computers did in those days on a daily basis. They did if you were in the computer science department maybe, but not if you're on an English degree. So that was probably entertaining point number one using computers, and then the final one was actually I got really into chaos theory about – and this is all about university education, yeah? You know, I spent most of my time on the wrong floors of the library. I mean English was on, you know, I don't even know what floor English was on, to be honest, but I do remember the science ones were higher. And, you know, I read *Relativity* in German, you know, because I'd been given an education, I had an A/O level in German, I could read German, so I read *Relativity* in German, why not? You know, that's an education, you know, to get the style of Einstein writing in German, you know, without translation, is brilliant. You know, or to, or researching chaos theory, which was a relatively new thing at that stage, you know, but the university had loads of good books on it, so why wouldn't I read those books. And then why wouldn't I start, you know, trying to create my own strange attractors on my Amstrad word processor. And of course then I was let down by the resolution of the screen on the word processor, because it was very low resolution, so then I wrote a little program that would actually generate bits of strange attractors, and then basically I could take the individual files then merge them together in a desktop publishing application and print off these amazing high definition graphs. And of course that's, you know, that's another story, but that led me to IBM.

Did IBM find you?

Erm… that's a real… can I remember? No. No, I found them, because I saw an advert in my university for an, well, summer internship type thing, yeah, it was a competition, called Elite, where basically the idea was that you were a computer science graduate and then you would go into local firms, do something with the local firms and then IBM would give a cash prize out to the people that came top, yeah? And so I went along to the interview, which was held by an IBM CE. Now, the CEs were the hardware guys, alright? So he didn't really know what he was talking about either, so he decided to interview us on the basis of, on the Microsoft DOS manual as

far as I could tell, so he was asking us what, you know, what commands you'd need to do to do certain things on a PC. Now, I had a bit of experience on PC, but not very much because I was mostly using CP/M, so the command to copy things on CP/M is PIP, you know, it's not copy. But I knew just enough to scrape through on this, on this interview with being challenged on Microsoft DOS commands. Might have even been IBM DOS in those days, who knows. And, you know, I was able to share some programming I'd done on other things. So they let me on the scheme. I was the only English graduate, obviously, on the scheme. Everybody else was computer science, I mean literally everybody else was computer science. Because in those days, again, you know, there was no expectation that unless you were doing computer science you would have access to the university computers or anything like that. So I went on this scheme, had a great time, in my holidays, computerised the accounting of a stainless steel fabricators, okay? And little did I know that by doing that, I basically was able to produce a list of all the people that owed them money on a daily basis, and I took it on as part of my job to phone those people up [laughs] every morning to get the money in, because I thought well, while I'm doing this I may as well do it properly. So the guy absolutely adored what I was doing, because first of all it was the first time they'd ever had real time accounts or knew what their cash position was, and of course by doing that every morning I turned around their cashflow. So I didn't know, but they were in a cashflow crisis before I arrived, by the time I left they were fine.

[00:40:00]

And the guy was so grateful he said you need to come back next holiday, I want to do the stock control. So I came back and computerised the stock control. So I did very little, I mean I did a little bit of programming in terms of shell scripts and this kind of thing, to make the software automatically boot and give them easy access to the word processors, so I would create a lot of menu system things. But I did no real programming, whereas everybody else on the course took it as an instruction to go off and program something. So all I did was just put an accounts system in and put a… But of course, IBM looked at this and went… you did what? What do you mean, you turned around the cashflow of an organisation? Yeah, you know, you win. So they gave me the prize, much to the chagrin of all the computer science graduates, obviously, who thought they'd done much more impressive things, which they had. I

mean they'd written more imaginative code than I had, that's for certain. But fundamentally, I was offered a job, but of course I told them, well I didn't quite tell them to bog off, I said, but it's okay, you know, so they basically said, when you leave university we'll offer you a job. I went, it's okay, I've already got a job lined up with the BBC, which I did. So I said, you know, so thanks but no thanks, you know, I'm joining the BBC because, you know, the other set of holidays I've been working with the BBC. Oh, that's a shame, they said, but they remembered who I was, and when it came time to leave university I didn't really know what I wanted to do, still, at that point, so I basically applied to the BBC and to IBM, and to a school actually, I didn't know whether I wanted to be a teacher or not. Failed at the school interview, so that was fine, accepted at both the IBM and the BBC interviews, but then I got into the conversations of what happens next, you know, in terms of… And the IBM recruitment person was basically saying, you know, we have, you know, BBC said, well, for the next five years, or three years or whatever it was, you'll be doing this. I was going, but I already do that, I've been doing that for free. You know, I've been rigging at outside broadcasts and doing all kinds of amazing things, you know, with the radio team, I know how to do all of that. Yeah, yeah, but you've got to do that for three years, and then at the end of the three years you can do the next thing. I said, right, so when do I get to go on the BBC Director course, which is what I wanted to do. So it was looking like that was going to be at least eight years away, you know, before I actually get on to do the thing I actually wanted to do. And of course the answer – did the same thing to IBM – and IBM said we have no idea what you'll be doing in three years, never mind, you know, it could be any way, could be doing anything, and painted a very different picture of an organisation. And I went, I don't think I can live with the guys over there, they're too much like the academics, I need to work with the IBM-ers. So I said, IBM, you know, I'll come and work for you. And they said, alright, well, we've got a selection day coming up, you're a bit late, but we'll drop you into this selection day. And I had a great time at the selection day, you know, and wound up with all kinds of people from Oxford and Cambridge and things, it was marvellous. And then came out the other side, so they said, right, we think we've got a job for you in Newcastle. Right. But you're going to have to go up there and do an aptitude test, because we've already got an intern in there who we think we might want to offer a job to, but no one really likes him. They actually said that, nobody really likes him, but he's very bright and he's very good, so we want you to

do an aptitude test side by side, almost, you know, to see which of you comes out top and we'll offer the job to whoever comes out top, because that makes it a fair competition. Oh, okay. Alright, I'll do that then. So, literally went into IBM Newcastle, almost exam conditions in IBM Newcastle, it was bizarre, you know, in a conference room, just the two of us, with a, you know, a multiple-choice intelligence test kind of thing, yeah? And this guy, you know, I think he was Oxford maths or something, you know, he was, anyway, he was, you know. And they said at the beginning, just so you know, just to make things fair, Richard's done English so he won't be very good at maths, so we're going to give him a few extra points to balance things out. I just decided to sit there going, I'm just keeping very quiet. And basically we were all, both in the same room, so I just decided I was going to psyche this guy out, so basically, every time he turned the page, whether I'd finished the page or not, about three seconds later I'd turn the page. And sweat started pouring off, by the time we got to page five or six, sweat was pouring off this guy, because this guy who was an English graduate was keeping up with him and he was working as billy-o, as fast as he could and this kind of stuff. So he was probably making mistakes by that stage. So he finished his test and obviously he was expecting me to finish three seconds later, and of course I went back to the beginning and finished gradually and slowly and probably got the answers roughly right, because actually I wasn't too bad at maths either.

[00:45:17]

And of course my scores, whether they, you know, with or without the additional scores, I think my scores were probably pretty good anyway, and they just went, you've got the job, you know. Anybody, I mean because obviously we were being observed, they just went, anybody who can be as Machiavellian as that, you know, it was so obvious to them what I was doing, because they could see I wasn't finishing the pages, I was just moving over. Anybody who's as Machiavellian as that and gets the answers right and has done an English degree, you're in. And unbelievably then they phoned up the local general manager, the Newcastle manager and said we've got this bloke, Richard Hopkins, you know, we think we should hire him. And at this point the manager goes, what, Richard Hopkins? And they went, yes. He went, what, the one that won the Elite Award? And they said, did you win the Elite Award? I

went, yes. And they went, why didn't you tell us that? [laughs] So basically the branch manager knew who I was anyway, so it was just one of those things, it was going to happen anyway, but it was nice to get it in that kind of way with a lot of, you know. I think I got it fair and square because there was a lot of competition. And I missed out the bit in the group sessions where we had to do presentations, and of course what I presented at the group sessions was all my high-definition work on foils, on chaos theory, and of course I started the presentation with, and as you, as of course, as you know, IBM Fellow, Benoit Mandelbrot, invented this whole kind of… And everybody in the room went, who did what? [laughs] Because even though they were IBM-ers they had no idea who Benoit Mandelbrot was. So the computing helped me get into that end as well.

So you joined in September 1990?

I did, yeah.

What was the culture of IBM at that time?

What was the, sorry?

Culture of IBM?

Interestingly regimented. So basically, the day I joined was pretty much, was the day they released the ES/9021, which was the… so this was the 3090, this was the next generation of mainframes. And to give you an idea of how important, I mean the stuff is still important to IBM even now, but to give you an idea of how important it was back then, everybody in the branch had to go into a conference room, including the secretaries, they left, they literally left one person answering the phone, yeah, for the whole of the branch, and everybody got briefed for a whole day on the intricacies of the hardware, the software, the new features of the IBM mainframe. Everybody, irrespective of what their role was or what, you know, secretaries to systems engineers to customer engineers, to people like me who'd just joined, sitting there going, what the hell's a mainframe. You know, very, very, very interesting culture. But of course, so there was that element of it, but at the same time there was the recognition that

things had to change, and change quickly, because we, at that point we hadn't registered, I think it was a year after I joined, it felt very personal, certainly, we registered the largest ever single quarter corporate loss in history about a year later after I joined. And I don't think that's actually ever been, anyone's ever broken that record since. So over the year, I mean other companies have lost more money over a year than we did since then, but in one quarter we registered the biggest ever single quarter loss and I believe that's an unbroken record even now. You know, so imagine what this number of years, 30 years of inflation does to that. So, yeah, we were in an existential crisis, almost from the point at which I joined IBM. And I was part of that new guard, I was part of the new way of doing things and, you know, I was sat next to somebody so that my – who'd been an IBM-er for 20 years, I think – unbelievably his job was to look after, from a technical viewpoint, the customers of Lotus 1-2-3/m, which was Lotus 1-2-3, which is an Excel spreadsheet running on a mainframe, which is the worst possible experience in the world.

[00:50:03]

Did we have any Lotus 1-2-3/m licences anywhere in the country? I'm not sure we did. We certainly didn't have any in the north. So he wasn't very busy, and they sat me next to him so that some of my enthusiasm would rub off on him. I mean, seriously, this is what they… they needed to reinvigorate the workforce and, you know, the idea of reinvention of the individual had not really taken root in IBM at that point. It has now, you know, and it has done for probably 20 years, but that was the point at which it became obvious that people needed to be able to reinvent themselves during their careers on a continual basis, because probably half the people in the branch were not that busy, you know. And it was a huge branch in the north-east of England, I mean there was over a hundred people in the branch, you know, probably about 150, I don't know. Certainly a hundred. And, you know, we were on multiple floors of an office block, I mean it was, you know. And we had customers all over the place, you know, Nissan and all the shipbuilders and there was ICI. You name it, I mean we had a huge customer base. And I was part of that new guard, so I was PC and Unix, you know, so no one knew what I was talking about, full stop. I mean I was literally the only person, there was a Unix specialist who was part of the branch when I joined, but he very quickly got poached off and went off to Sequins or some

other new fancy organisation for twice the money. So yeah, it's, it was a time of radical change.

And Akers was chopped?

Akers got, Akers went, yeah.

And for the very first time they looked outside for someone to lead them and they got Mr Gerstner.

They did, you know, Mr Biscuit King. So yeah, I mean he was and remains brilliant. You know, British people tend not to have, you know, I suppose we might have some level of reverence for the monarchy still or whatever, but we don't have, generally I don't think we have, we don't have reverence for individuals, you know. So I think Gerstner's a really clever chap and, you know, and I've spoken to him and, you know, but literally the Americans revere him. I mean, you know, the American IBM-ers revered, won't even go anywhere near him, you know. You know, if he's, you know, walking down a corridor they won't, generally speaking, they won't speak to him or anything because they just hold him in such high regard, because he did reverse virtually every decision that his predecessors were making and completely turned the company around. It was, it was amazing to behold, actually, you know. And ever since then I've always wondered, and hoped that the subsequent CEOs would do similar things. So far none of them have. So, yeah, I regard him as being, you know, he came in, looked around and went, no, no, no, what makes you unique is you doing the whole thing, is you being IBM, is being end-to-end, I can't see that anywhere else in the market, why on earth would you change that. And that is what resulted in all the e-business stuff and, you know, the growth of our services area and all that kind of stuff that resulted in a huge regrowth of the company.

And to use his own phrase, he made the elephant dance, did he not?

He did. Yeah, I mean I'm still not quite sure it was quite doing the foxtrot, but it was certainly a nice waltz, you know, which was definitely more than we were doing previously, you know. And these days, you know, the journey continues, I think.

But, you know, but it's, yeah, it's hard to explain just how much of a cultural difference he brought in such a relatively short space of time. You know, every CEO since then has massively benefited from what he did.

[00:54:38]

What was the training like?

Generally speaking, it was exceptional and occasionally mind-blowing. So a lot of it was driven by the people on the ground, there wasn't as much centralisation, there wasn't so much learning by watching stupid videos or, you know, there was an expectation that learning was experiential, generally speaking. And, generally speaking, learning was taught by practitioners. And I just found that wonderful. So the best course I've ever been on was a performance engineering course that was run by somebody who, I don't think he ever got beyond band 9, I think he was band 9 when he retired, which is not a very senior band, you know. Executive is band- the bands in IBM work strangely, so if you come in as a graduate you're band 5 or 6, you know, and then you work up through the numbers until you get to 10, and then it bizarrely reverses into letters and goes backwards. So 10 is the last non-executive line, and then basically you go D, C, B, A and people have invented other ones since then, like double A. But fundamentally that's how the… And so this guy wasn't very senior in IBM terms, but what he was was incredibly senior in terms of learning and he'd been working with the, you know, the largest companies in the UK and had built up an entire generation worth of understanding of how to do performance engineerings on IT systems, and how to model availability and how to do all kinds of things. You know, and some of this was coming from a mathematics background, you know, some of it was just not very well-known things like Little's Law, which should be known by everybody. And other bits of it were queuing theory and a lot of it was applied knowledge about, you know, where do you put data on a disk to minimise latency and all that kind of stuff. But it was *the* most eye-opening course in terms of how to engineer a large-scale IT system because he, you know, he just gave over an entire career's worth of knowledge in the space of about three or four days, all of which was underpinned by, you know, you've got a client with this problem, you know, here's the relevant facts and figures, you know, work out what you don't know

and tell me what to do about it. You know, those kind of… So those bits were, I just found adorable. I mean that was just like, how, you know, to absolutely be able to absorb that much knowledge in a relatively short space of time through experiential learning via an expert, just can't be beaten. The other element of it, which I found extraordinarily powerful, was that whether you were technical or sales or anybody, you all went through this process of doing sales, essentially cold calls, sales calls. But if you were technical you had to combine those cold calls of going in to see somebody you'd never met before to solve a technical problem, with the technical problem itself. So the sales people just had to go in there and be nice to people, generally, or not, depending on what the brief was. We had to go in there and be nice or bad, but also have the technical content. And we used to do these calls, and you'd do them against managers and peers and all kinds of, you know, but they were part of the ethos of the company and it meant that you got people who were very good and very good technically, but they were forced to become really good communicators and listeners. You know, that was a really good education. You know, so those two bits combined I just felt were, you know, that's how we grew the company. And whenever I'm given a chance, you know, I reinstate some of those practices with the graduates we have today, because of course the standard approach is to do remote learning and to do everything via, you know, videos and the like and it just doesn't, I don't think it impacts people at the same level, you know, it doesn't change the way they behave and think and do things.

You like training? You're a good trainer, are you?

You'd have to ask… yeah, I've generally had good feedback apart from when I've taught in Europe.

Really?

Yeah. Because I speak quite fast, as you might have noticed, and I'm also from the north. And what you don't notice, because you're British, is that everybody in the north speaks with glottal stops, yeah? Which means you kind of drop the end of the sentence pretty much all the time, which means that when I'm teaching in Europe, people can literally not find the end of the sentence. So they are constantly trying to

parse where the end of the sentence happened. Well, did it happen now or then, or, you know, and they're so worried trying to work out when the end of the sentence was that they lose the next sentence. So, yes, I'm really bad at teaching in Europe, but I'm not too bad at teaching in the UK.

[01:00:18]

You became an IBM architect.

I did.

To misuse a term, yet again. And you had something to do with Post Place solution for counter automation in the Post Office.

Oh yes, there's a controversial topic for you.

How does that connect with Horizon?

They were my competition.

Ah.

Ah. Yeah, I mean at a very young age, I mean it was a $2 billion bid, I think, might be even £2 billion, to run not just the Post Office systems, but also to run the DWP's payment systems behind the scenes as well to pay the benefits. You know, so it was a huge procurement. Eventually obviously it got whittled down to just the Post Office bit, which then got implemented as we saw. Very interesting procurement. I learnt two things in that procurement. No, three things. First thing is that, you know, the first thing is that the fundamentals of engineering are really important. So, the IBM system that I bid, that I helped create, that I was the chief architect for, was called Post Place. Post Place was ultimately sold to the USPS system, US post office, which is roughly the same size as the UK post office even though it's for the whole US. They don't have, they didn't have quite as many counters, I mean in those days the Post Office had 40,000 counters and 20,000 locations, which is similar to USPS. The

USPS system has worked fine for many years, has not got people into trouble, has not dropped transactions. Why not? Because it is transactional. Why is that important? Well, because in any system where you've got 20,000 locations and 40,000 terminals over those locations and they're doing hundreds to thousands of transactions a day per terminal, a one in a million chance of something going wrong because you haven't engineered the thing right becomes a daily certainty, not a blue moon thing. And until you get that into your heads, as an engineer for IT systems, you are completely lost. Because otherwise you try and apply the learnings you've got from building a small system to a big system, it doesn't work. You have to fundamentally re-engineer systems to work at that kind of scale so the one in a million chance does not happen, because the one in a million chance becomes a daily certainty. And that's what really frustrates me about what happened in the UK, and upsets me even now. Because basically, you know, if you engineered it right, it's not going to happen. But there was a lot, you know, the procurement was a very long procurement. It was actually technically pretty rigorous, but there was a huge degree of liability being transferred to the suppliers in those days, very unusual, unlimited liabilities, this kind of thing, which of course never actually really materialised but that's what the contract said. So, you know, we were doing quite well in the evaluations from a technical perspective, especially on the Post Office side of things, and then of course at the very last minute our headquarters saw the terms and conditions and went, we're not signing up to that. So I'd been working 100-hour weeks on this bid. I mean I kid you not, it was before I met the wife and everything else, you know, I was learning and working, learning and working and, you know, putting this thing together, you know. And I learnt at that point, you know, one of the other lessons from that bid was never to work that hard again. Because despite the fact that I established our reputation with the Post Office, despite the fact I'd had a technically superior solution, despite the fact that all those things are working in my favour, my headquarters after a year's worth of procurement basically went, don't like that. And as a result I think we had penalties of, I think there were about at least a couple of, I think it might have been 100 million, might have been more than that, slapped on the price of the bid because we didn't like the Ts and Cs, and therefore we completely lost on price, even though the actual solution itself was pretty competitive.

[01:05:00]

So yeah, so I learned lots of things on that one. You know, never work that hard again, never assume that you're in control, and ensure that you're engineering correctly at scale. Because, you know, because that's the other thing, in retro… I learnt this long before, you know, the thing became a scandal, because I did lots of work on welfare systems and other things as well, but you do learn that every single decision you make as an architect, or every line of code you write as a developer has an ethical implication and you have to be thinking those through. You know, how will people cope if they can't get access to that, how will they, you know, how do you prevent people being digitally left behind, all that kind of stuff has to be part of the landscape of the IT professional. You know, we're meant to be chartered engineers, ultimately, you know, we need to start behaving as if we were chartered engineers.

About this time, because you were seven years as an IT architect, and towards the end of this time we've got the wonderful, some say scam, some say absolutely essential work on Y2K. What's your opinion on that, Richard?

I mean, to be fair, I wasn't really involved very much. I mean I was busy building new systems, not fixing old ones, at the time. However, I do know lots of people who were working and fixing and we did find some pretty outrageous stuff. You know, including systems that were still working in pounds, shillings and pence behind the scenes. You know, so I get this from my family, you know, that they say well, it was all a complete waste of time and a scam, because nothing happened. Yeah, the main reason nothing happened is because we fixed the bleedin' code, you know. It wasn't that difficult to find the places where it needed to be fixed, there were just an awful lot of them, you know, because in those days computing was expensive and two digits versus four digits was really expensive, you know. So it was, yeah, I still find it bizarre that because a disaster didn't really happen it's therefore regarded as a scam, whereas I regard it as being a minor, you know, a really good example of how the computer industry can pull its socks up when it needs to. Because we did an awful lot of automation and static code analysis and all kinds of other things to find all those places. It's not as if we paid people to go through the code one line at a time and, you know, did it as slowly as we possibly could to make as much money as possible, no,

we automated this stuff to find this stuff so it could be fixed. And, you know, it was the testing, the re-testing that cost the money, I mean and presumably people would quite like us to re-test things when we change them. You know, that's another one of those little principles I've got.

You've been working quite a lot with government, central and local, but particularly central government.

Yeah.

Now, public sector, just by the profile, doesn't have a very good record of IT systems, does it?

[laughs]

One, would you agree, and if you do, why?

Why? I have anecdotes. I mean the general problem used to be, and I can show you counter examples, but the general problem used to be the distance from the user. So, you know, I remember, well, there's two distances. Distance from the user, distance from the policymaker, okay? Because the requirements are coming from the policymaker quite often, and another set of requirements are meant to come from the user quite often, and then of course there's a third pillar which is the existing complexity of the estate, the brownfield elements. So those three things combined are almost guaranteed to be a train wreck if, first of all, you don't engage with the real user and you accept the fact that you're going to work with a bunch of proxy users who are analysts from the government department who pretend to know what they're talking about, but often have never even met a real user. So that's kind of disappeared over recent years because of Agile, which has been incredibly useful for reducing that gap. You know, we now do user research, we now do Agile practices in government that make a huge difference on that side. Policy one? We still haven't fixed the policy one. I mean, you know, I remember having a whopping argument with some policy people who came in on – I won't mention what system it was and whatever else – but basically, you know, at our request we'd said, listen, can we talk to the

policy people who are working on this new thing, because if we can get the policy right it'll make the system much easier to enable and it'll make it much easier for people to use, you know.

[01:10:02]

So if we can influence policy in the right direction or in the right way. So they brought in these policy people from Whitehall who were considerably younger than me, and I was quite young, who'd clearly just got out of university, you know, one of the best universities, obviously, and basically when we sort of said, right, when you're doing the legislation, you know, is it possible to do it this way rather than this – and this is all secondary legislation, it's not primary legislation – and they went, oh no, no, we're cut and pasting that. We went, what, what? Well, we've only got a limited time to actually write it and a very few number of people, so we're going to take that Act over there and that thing over there, we're going to cut and paste that and cut and paste that, cut and paste that, make some minor changes and Bob's your uncle. O-kay. So all the complexities and all the difficulties of the old system, by the way, the old system doesn't actually match the legislation, we've just found that out, so we've been mis-paying people for however many years, you know, and actually everybody's decided the best thing to do is fix the legislation rather than the system. Everybody likes what the system's doing and no one likes what the legislation says. But what you're saying is you're now going to cut and paste that legislation into the new thing for the new system to work from? Yes. Have we got an opportunity to change it? Oh no, parliamentary timetable, ohh. Right. So when should we have engaged with you to prevent this? Well, you couldn't have done, because we've only got this limited time to do it in, so we didn't have time to rewrite anything, so we had to cut and paste. Okay. So you ended up having to, you know, implement something that was vastly more complicated than it should have been, in my opinion. You know, we did try and fix it, but there's these two… this one we fixed, this one I still think the policy thing is still a problem. And the other one of course is the brownfield element, you know, this was, what we just talked about was brownfield policy. You know, cut and paste a policy into a new policy, you know. We have the same thing with the IT systems, they impose limitations, constraints, complexities. Sometimes you've got to enshrine

those in the new systems or whatever else, that can slow things down and make things very difficult, or even worse, you get some 'challenged' person saying, I want the new system to work exactly the same way the old system did. You know, which is just the requirements you look at and go, run! You know, don't want to do that, don't do that. So those are the fundamental reasons I think why we've had problems and it's fair to say that I think, especially with user research and actually to some degree with devolution, I think if you looked at what's happened at, say, the Scottish government level, yeah, you would find a quite different story, actually. So it is possible to do it, you know, by bringing the policy, the systems and the people much closer together, then you get into an environment that feels a little bit more like a commercial environment, but frankly, you know, I've worked in banks and other places as well and, you know, I actually prefer working in public sector. When you get that combination right, it is the best place to deliver it, actually, because you know you're working with the people who are trying to do the right thing on one side and the people who you're going to impact on the other and they're all within talking distance or walking distance, you know, almost. Makes a huge difference.

Though the public sector cannot choose its clients. A bank can.

But that's, you know, but their clients are the ones who pay the bills, generally speaking, you know. And even if they're not paying the bills, there is still a responsibility of care, you know, a duty of care. So yeah, you know, I still think, you know, I'd still like to see more radical things going on in public sector, you know, in terms of really thinking through whether, you know, even the structure of departments and all, you know, fit the modern world, you know, are there unnecessary boundaries in place and this kind of thing or, you know, do things need to get reshaped to make them flow better, you know. But, you know, those things are big philosophical things about how government should be organised and, you know, maybe, you know, you get one of those kind of people who are going to, you know, radical re-shapers like that, like Gerstner, seem to only come along once every couple of generations, they don't seem to happen every generation.

[01:14:50]

Fifteen years after you joined IBM you became Chief Technology Officer of IBM UK.

Yes. Oh well, no, Chief Technology Officer for our…

Public sector.

Public sector, yeah.

Okay. And in May 2011 to the present day you were appointed a Distinguished Engineer.

[laughs] Which is a wonderfully hubristic title, we're good at making up titles, aren't we?

There are two subjects that are interlinked that are very modern and very much subjects of debate that I want you to talk to us about in the Archives, your views on. Let's start with something that you were, well, both of them, you're a speaker for IBM on these subjects and an expert. On Monday this week, The Times *reported that in a paper published in* Nature*, the scientific journal, a couple of academics have come to the conclusion that the actual application of quantum computing will hit GDP because it will take some time for organisations, public and private, to actually compensate and invest in it and it therefore means it'll hit GDP. And they say that that happened as well with the PC and the internet. Do you think that's going to happen?*

Well, if that's what they say happened, [laughs] it could well do. I mean if that's what happens with any significant technology, maybe. I would hope, you know, that on this particular occasion the government have said they're going to invest, you know, £2.4 billion over the next decade in quantum and create the conditions in which the UK can actually generate some money off the back of quantum technologies. So that's, that might mitigate that somewhat. But I would concur with them that the area that the government and all the areas around government are really – and I think the

right word is lackadaisical on – is the industry adoption and exploitation of the technology, yeah? I am seeing nowhere near enough focus on communicating into those areas that there's something they're going to need to adapt to, there's something they're going to need to absorb, you know. The mega-corporations already know about this stuff, you know, and are making plans and doing things. I don't think the large firms are to much degree and I'm sure the ones below them definitely aren't. And it will impact everybody and it will be available to everybody, pretty much, you know, because it's going to be cloud-based and everything else. So there's a, you know, they need to start asking themselves, I've clearly got a skills gap, how am I going to bridge that skills gap. You know, do I need to work with a small software company that's going to give me a quantum optimisation algorithm, you know, how am I going to use it to optimise my cashflow or my stock control or, you know, or whatever it is I care about, my logistics, you know, how I'm going to get things delivered. Well, you know, these… absorbing a new technology's always tricky and the smaller you are, the trickier it is, yeah? So, building that ecosystem of enablers around the industries that matter to the country, you know, I'm not seeing enough focus on that, I agree. So, you know, could there be this backward step, you know, if we, on GDP if we don't get that bit right. Oh yeah, yeah, there could well be because I'm sure other countries are pushing harder and faster. You know, the US certainly is. The US has already issued edicts about, you know, quantum safe cryptography. Still waiting on that from the UK, but there you go.

Is there enough money?

To do what?

To do what the programme says it's meant to do?

Probably. I mean the programme is all about creating this bedrock of technology and skills and capability predominantly in the academic and research area, yeah? I mean that's the focus. So for that, yeah, probably.

Do you think that focus is right?

But this other bit, this gap, if you like, between industry and the technology, no. No, there definitely isn't money there to do that. Nor is there the people who are focussed on it, nor is there, you know, the organisation structure in place either, you know. So that is something that, you know, again, to anybody who's willing to listen, I'm telling them about it. So yeah, it's important.

[01:20:01]

I interviewed Sir Peter Knight for the Archives, he's the Emeritus Professor at Imperial College, and he's going round the world talking and picking up information about quantum computing. He says that a real quantum computer that's going to be stable and really workable is a decade away.

Yeah. He's wrong. He's already wrong. [laughs] I mean the thing about this technology is that, I mean I've been involved in it, what, for five or six years, five years now. It's quite long, it feels like longer. But fundamentally every time you look, things have moved forward faster than you expect. You know, I mean we were talking about, you know, well, let's just talk about what's happened in the last few weeks, you know, or few months. For example, within the last month or so IBM's announced that - in *Nature* - that we've actually done some very precise calculations using a noisy computer, a noisy intermediate upscale quantum computer, using all 127 qubits to model the spins of atoms, yeah? And we've been able to prove that the quantum computer, for a certain set of conditions that are well known and well computable, like the Clifford conditions states, that we got the answer right, exactly right. And then for the next set out we used a supercomputer and one of the universities verified that the approximate answers that we were able to calculate, they were able to calculate on the supercomputer and their approximation methods, you know, were in agreement, you know. We got slightly different answers, but, you know. And then there's a whole series of answers that no one can verify because there's no computer big enough on the planet to be able to verify them. So we've issued a challenge to the academic community to say can you come up with an approximate way or a supercomputer, you know, way that's going to be able to verify whether we got the answers right or not, but we think we did because we've proven that the other ones are right. So if that's the case, then we've already shown that for a

scientific problem we can use noisy intermediate scale quantum computers using error mitigation techniques – not error correction – error mitigation techniques to come up with a precise answer. Now, it takes a while to do that, because the way you do it is you run the experiment many, many million times and you, and that allows you to muddle the noise and reverse extrapolate the noise out of the… and you get the exact answer. Okay? So, you know, is it cost effective to do that for normal day-to-day problems. Probably not. Is it cost effective to do that for really challenging problems that can't be computed today that are actually very high value. Well, it might be. You know, a day's worth of quantum computing time might be affordable for certain use cases around optimisations or problems that simply can't be computed any other way. So, although we're not claiming we've got to that quantum advantage point where it is cost effective to do a typical optimisation for commercial use type thing on a quantum computer, you know, because generally speaking you want answers back in less than a day and you want, you know, well, the fundamental thing is you want answers back in a day and that's probably going to cost you a lot of money, an entire day on a quantum computer, especially one with 127 qubits. So there's a certain element of efficiency, engineering efficiency that we have to solve. But the fundamental problem that everybody thought was going to require logical qubits, which would require, you know, maybe it's a thousand, you know, anywhere between 250 and a thousand qubits, noisy qubits to create one logical qubit, that is no longer a problem. So I agree with your colleague, you know, in the sense of if you assume you need logical qubits, that's a long way off, but if you actually, you know, are happy with a longer run time, more cost and using noise mitigation techniques, you know, error mitigation techniques, then actually, yeah, I think we're kind of in the ballpark already. Now, we've got a roadmap that extends out to low numbers of tens of thousands of qubits already, and that's within the next few years, okay? And at the moment we don't believe…

[01:25:08]

Is that a public document?

Yes, absolutely published, yeah.

Where would I get that?

IBM website. If you look up IBM Quantum and just search 'Quantum roadmap', yeah, you'll find that there's a roadmap that shows Kookaburra, I think at 4,526 qubits plus, it says, yeah? And then if you look at our latest press releases when we're talking about IBM quantum supercomputers, you'll see that it says about tens of thousands of qubits being within reach. So the techniques in that Kookaburra system, which at the moment we don't see any fundamental problems with, you know, these are, we think, known challenges, gets us to probably the low tens of thousands of qubits, yeah? And then the next step is to get to hundreds of thousands of qubits, and we're, you know, we're forecasting that to happen within a decade, yeah? Now those are going to require research, but we've already got stuff that's showing us how to take, you know, in principle, you know, we've got little experiments in principle showing that we can take all the kind of paraphernalia we've got outside of the quantum computer to shape the micro-signals in to get them in, then they have to be attenuated down and amplified back up and all that kind of stuff, to actually put that inside a fridge at near zero using CMOS. So, you know, that's going to reduce the complexity of the quantum computers in terms of controlling them, in terms of controlling the qubits, and the energy consumption, you know, will go from 65 watts a qubit down to milliwatts a qubit, you know. So it's things like that are going to radically transform this generation of machines to the next generation of machines. Now, we haven't built one of those yet, but there's a clear roadmap, you know, a published roadmap to get to, you know, 10,000 qubits, or tens of thousands of qubits as it's worded, you know, and research projects ongoing to get us to 100,000 plus, or hundreds of thousands, yeah. And that's why people are beginning to take things like the quantum safe stuff seriously because, you know, this is more of an engineering problem than it is a science problem.

You don't think it's going to hit the same barrier that Josephson junctions did?

Well, it doesn't… no, I mean it looks at the moment like it's going to keep going. I mean, because the ability to link QPUs together, the ability to do this, you know, this mitigation of noise, you know, Google have shown, using similar technology to ours, that they can actually create logical qubits which are where the actual error correction

is allowing for improved, you know, longevity of the logical qubit itself. You know, so the bits of the puzzle are all slotting into place and rather than it requiring a huge leap or a huge step change in capability to get to the point where it's commercially viable, what there now appears to be is a relatively smooth path of increasing levels of noise mitigation, increasingly large QPUs, increasingly large bridged together QPUs, increasingly large fridges, and finally the miniaturisation of the control software and control hardware to actually fit within the fridge itself. You know, these are all things that are plottable, if you like. So yeah, I think there is going to be an engineering problem somewhere that we hit, you know. I mean the fact we're using microwave pulses means that there's a theoretical limit to the clock speed of the quantum computer, you know. So we're going to hit, you know, there's going to be some things that the technology hits. But who says that, you know, superconducting, supercool quantum qubits are going to be the qubit forever. You know, there's stuff in early research like neutral atoms or, you know, or other ones that as they develop may turn out to be better technologies. So I don't think we can, I think what we can say is that it looks like there's a commercial way forward for the next decade or so, and after that who knows? I mean if enough money goes into some of these new, very promising looking qubit technologies, you know, including room temperature quantum computers, who knows, who knows where that'll take us. But the point is that by the time we get there we'll have some really good algorithms, some really good idea how to mitigate noise, and possibly even some logical qubits, you know. So it's not a… it's not as black and white as possibly your friend is describing it to be, yeah? I think it's now a series of graduated shades of grey.

[01:30:23]

Where was this work being done in IBM?

Everywhere. So New York is the main centre for the actual quantum machines themselves. Poughkeepsie is where they're hosted. We have labs in Zurich which are doing a lot of work on them. And the way that IBM research is now put together is that basically Dario Gil, who's the head of research, has encouraged the labs to actually work together on things, so you'll find projects spread right the way across the IBM geography. So literally when I say 'everywhere', I mean, you know, in all,

whatever it is, I can't remember how many we've got now, but you know, there's at least five main labs and another ten offshoot kind of labs, you know, in various countries. So this work is being done literally on a global basis, and of course it's not just us, there's also, you know, Google are doing similar work, Rigetti's doing similar work and there are other qubit technologies all going on in parallel. And the interplay between them, you know, there's obviously an increasing amount of trade secrets and everything else, but, there's still an awful lot of publishing going on which is actually bringing the entire field forward, you know, together. Especially all the work around algorithms and applications and this kind of thing, pretty much equally applicable to all the technologies.

And one of the big applications is going to be AI, is it not?

Well, yes, it probably will be. I mean I think initially machine learning in terms of classification algorithms and this kind of thing. So we've already got some good results from real data on a quantum computer around things like fraud prediction and prevention, because it looks like it'll change the scope and scale of those algorithms significantly, yeah? So that's quite exciting. You know, I liken it to the possibility that we'll move from, you know, client 360, or Know Your Customer, as being the primary way we do fraud prevention today with credit cards and this kind of thing by, you know, building a context about who you are and your behaviours and what you do and what you spend your money on and where and when and how, you know. But the number of false positives is still ridiculous in that space. I mean we all know that because we all get the stopped cards or the phone calls or whatever else, because the risk has largely transferred back to the banks. What we're looking at with quantum is that ability to start putting much broader contexts into those algorithms, so the machine learning algorithms have far more parameters within them. So maybe if it starts being feasible to start modelling criminal 360, you know, maybe you start looking at the scams and the schemes and the context of those and whether your customer is overlapping with a scam. And those kind of things could really change the level of… of all that whole area of the industry.

[01:33:51]

Did you, or would you have wished to sign the letter asking to pause GPT development?

Oh, that's an interesting one, because I know people who did sign it. No, it's… I think it's the wrong, it's the wrong thing to do, because I don't think we learn our lessons correctly if we do it that way. You know, today I'm talking to some fairly important people about quantum and I intend to be talking about quantum ethics, you know. Because I think that whole debate and that whole structuring needs to start now, but that should have been happening – well, it was happening, I mean IBM's been talking about AI ethics forever, yeah? We've been pushing this for over a decade since Jeopardy! You know, so just that no one was taking any notice. [laughs] So no, I think pausing technology's a pretty stupid thing to do and, you know, because, just because that company stops it doesn't stop any other company. And what we're seeing is that anyway is that the number of parameters in the model that comes out is not necessarily a proper indicator of the power of the model or the accuracy of the model anyway. So yeah, it was all a bit pointless, I thought. I mean it was a bit of a panic reaction and… I think it is pretty obvious, when I talk, you know, I think there was this assumption that the industry was suddenly going to adopt this thing willy-nilly and use it and be irresponsible with it. Whereas what I've actually seen is most of the customers going, it's not very reliable is it, it hallucinates, it does all these strange things, I can't use that, it doesn't explain its decisions, I can't use that. You know, so what I've actually seen is a pushback, is that technology grows again, ooh, really excited, technology grows. You know, getting very excited, and then the industry's gone, well, yeah, we need to learn how to use this for certain narrow areas like productivity for this and certain areas like this, but I can't use it in my general business to make decisions, because it's rubbish.

It's a black box.

You know, it's, first of all it's a black box, and secondly it's not very accurate, and third, you know, when it hallucinates it can hallucinate in a really bad way. I've got my own anecdotes about this, which unfortunately we don't have time for, but they do

involve taking my robot dog into a school and it hallucinating in front of the school. Unfortunately the hallucinations were absolutely bang on and they weren't things it should be saying in front of a school. It wasn't rude, but, you know. But, anyway. So, you know, I re-engineered my robot so that it can no longer tell hallucinations or lies, so that was lesson learnt for me, yeah? So I knew this about a year ago, because that's when I kind of rewrote it, but I'm seeing the same response from industry. So I think it was an over-reaction because I think people were assuming that people were going to be irresponsible, and that's not been my experience. You know, that people are clued up enough to go, no, no, no, this only works for a series of key use cases. And it will be used in an awful lot of places, but I think what we're going to see is much more focussed use and much more controlled use and safeguards and guardrails being put in place to ensure that it does the right thing in the right context, and therefore not quite job done, because I think that all needed to be thought about and said before the technology was released to the public, because that's what caused the problem, it suddenly became publicly available. Those of us who were on the Beta had been using it for a year already, had already worked out its shortcomings and had engineered how to get round them, you know. Or where not to use it and when to use it and this kind of thing. So it was a bit of an over-reaction to the public reaction, I think.

Recently I interviewed someone else about AI and he tried to sign that letter, but the server crashed.

[both laughing]

I did love that.

There you go. No, I mean once the technology's out the bag it's very hard to put it back in the bag. You know, do the thinking before it gets out the bag in the first place.

I think that's a brilliant place to end this fascinating contribution you've made, Richard Hopkins, to the Archives. Thank you so much for your very valuable time.

Richard, thank you. Great to meet you.

Bye.

[end of recording]