Sir Nigel Shadbolt

Interviewed by

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Welcome to the Archives of Information Technology. It's the 12th of October 2017, and we're in London, at the Livery Hall of the Worshipful Company of Information Technologists. I'm Jonathan Sinfield, an IT professional and an interviewer with Archives of IT. Today I'll be talking to Professor Sir Nigel Shadbolt. Sir Nigel Shadbolt is Professor of Computing Science at Oxford University, and a Principal of Jesus College. He is Chairman of the Open Data Institute, which he co-founded with Sir Tim Berners-Lee in 2012. He is also a Visiting Professor in Electronics and Computer Science at the University of Southampton. During the course of his career he has made significant contributions to the fields of psychology, cognitive science, computational neuroscience, artificial intelligence, the Semantic Web, and Web science. The common thread running through his work is understanding how intelligent behaviour is embodied and emerges in humans, machines and on the Web. Sir Nigel was President of the BCS, the British Computer Society, 2006, 2007, in their fiftieth year, and in 2006 he was elected a Fellow of the Royal Academy of Engineering. In 2013 he was knighted for services to science and engineering. And more recently, in this year, 2017, he was elected as a Fellow of the Royal Society. Welcome Sir Nigel.

Thank you.

[01:54]
Sir Nigel, perhaps you could take us back to, to the beginning in your, in your roots, when you were born, and, and where you grew up.

Well I was born, I was born in 1956, and I'm kind of, the same age as the, of the Space Age I always like to say, you know, Sputnik and that. And, I was born and brought up, well I was brought up in Derbyshire, in the Peak District, which is a lovely part of the, the world, rolling hills, a small village, Ashford-in-the-Water. And, and went to school, local grammar school. And, it was a very lovely existence. I was always passionate about science. I remember reading endless books, actually, a lot of science fiction, but it inspired me to think about, about all sorts of things from robots to aliens, and, I also had a passion for astronomy, so I spent a lot of time looking at the stars. Derbyshire and the Dales was not a good place to look for stars, there was often lots of cloud, and it rained a lot. But, but undiminished, I was very lucky, my

parents were, were wonderful, they were, they were… Actually they had not been to university themselves; my father was a local bobby, a policeman, and my mum worked as a, as a secretary in a, in a local teaching college. Yeah.

[03:20]

Yeah, OK. So, so a fun life in the Peak District then.

Well it was, it was… Yeah, it was, I say, it was quite bucolic in a way. I mean it was a, it is a beautiful part of the world, the Peak District, close to Chatsworth, a National Park, the first National Park actually established, and, you know, you could roam, you could roam the fields. I always had to be quite careful, I think it's quite interesting that as a, as a child of a, of a local bobby, you know, the surveillance society was already in place. A small village, you know, most people knew what you were up to. [laughs] So I had to, I had to be, I had to be above the law so to say.

On your best behaviour.

[laughs] A lot of the time, yeah.

[04:00]

Yeah. And, let's talk a little bit about schooling. Your schooling at that juncture in time, perhaps your secondary school.

Yeah, it was. Well like I say, it was a small local primary school, and then on to grammar school, the Eleven Plus was still in place then, called Lady Manners School. And, it was a mixed, so it had a reputation for being, it had always been mixed since it had been founded in the seventeenth century by, by Grace, Lady Manners. And so it had quite a proud tradition of, of that. It was a, it had been originally in Bakewell, and had moved to, during the Second World War to premises, it was an old isolation hospital. So it's slightly out, and, on a hill, and it can be quite cold and breezy on a winter day, but actually in the summer it was a lovely place to be. And, yeah, there was a lot of sport, there was a lot of, yeah, there was a lot of camaraderie, many of my friends, we came from villages and towns around that area, quite a large catchment area. But… And I was interested in lots of things. I could never quite decide, from

science and, and the humanities, through to, you know, making music and, and playing sport. I kind of, enjoyed the whole range of things that were on offer.

Mhm. And talk about your interests, when you went on to A Levels. What subjects did you study at A Level?

Well I studied, I studied the sciences, and, I had imagined at one stage that I would actually, you know, go into a profession. But, actually, what happened is, in the end I, I kind of, went down a very different direction. I, I had become, always had been interested in the nature of how our minds work and the nature of consciousness, and, and I had read these science fiction books, and I was captivated. I remember going to see *2001: A space Odyssey* in, when I was, well quite, quite a young boy, eleven or twelve, and, and how things, the, the mad, bad and paranoid, dangerous to know robot was kind of, kind of, rather grabbed my attention, I thought, well wouldn't it be amazing to, to know enough to, we could build a machine that can match the human being at playing chess, or, understanding language, or responding. I'm not sure about the self-aware, paranoid bit, but I definitely was captivated by that.   So the idea of going to study a subject that would kind of, get me to understand some of the conundrums and issues around how the mind works. So I actually in the end found myself at Newcastle University studying philosophy and psychology, and that was a really interesting mix for me. The philosophy in particular was a, was a route in to questions about, whether the mind could be mechanised, what was the nature of intelligence. I was taught by extraordinary teachers there. Geoff and Mary Midgley were a couple, Geoff Midgley, a wonderful logician who had worked and studied extensively on the area of, you know, the nature of language and could language be understood, and human abilities understood, in terms of programs essentially. So he was a very early kind of thinker in this area. And the psychology was often allied to that, questions around, you know, what's the basis of human intelligence in the brain? And this is in the, the late Seventies.
[07:30]
So, from there it was kind of a, a question of, well what next? And, I knew I wanted to do a PhD, but it always seemed to me I wanted to kind of carry on doing the research. The questions were just too interesting. And, at the time it was a choice between, if you like, the cognitive, the neuroscience basis of, of brains, and, and this

new emerging area of artificial intelligence. Well it wasn't that new, it had been around… Actually, again, I'm as old as the field. It was christened at a conference in Dartmouth, artificial intelligence, in 1956. So, it had been around for a while, but you know, it was making progress as machines became more and more powerful. And, on offer was actually a PhD in the only department of artificial intelligence in Europe at the time, which was at Edinburgh, and that's where I decided to go. Rather than going and studying the actual neural basis of vision in, in, [laughs] in living organisms, which was on offer at the University of Sussex. Yep.

[08:32]
Mhm. I think we can tell by the way you've spoken, but, the passion of the subjects that you… Which for you was your favourite subject during those early years?

Yah, I, I think it was… Actually, the biology really interested me. But it was hard to choose between them, because, you know, my kind of, interest in astronomy led to think a lot about physics and chemistry. And I was just intrigued by the whole thought of, how had life emerged. And I remember very early on being seized with this notion that there were kind of, three interesting questions, you know: how are humans intelligent; and, could we build an artificial intelligence; and is there any extraterrestrial intelligence, is there anything out there? And that seems to me still to be questions that we're all fundamentally interested, many of us are interested in. And, a lot of people who came into the field, and still do, have that kind of mix of interests around those kind of topics. And I wouldn't say that we privilege one kind of science or one kind of study over another; I think it's just the, the bigger questions, which all these subjects struggle to answer in any kind of entirety.

[09:44]
Mhm. And, during this early part of your life, you have mentioned at Newcastle, two influences.

Mm.

Came from a husband and wife at…

Yeah, they were actually. Yeah. Yeah.

Yeah. Was. Any other particular influences in, in that time?

Well, and you know, just, again, on the psychology side, yeah, one of my teachers, Chris Leach was actually involved in statistics and methodological design in psychology, but was also interested in, in AI. So I ended up writing a, a thesis in my final year on, on the prospects for artificial intelligence, equipped with my kind of, a bit of understanding for philosophy, and, and what was happening in the field of AI in 1978. And… But also, countervailing, there was, the other half of the husband and wife team was Mary Midgley, and she was – she's still alive, an ethicist, a very famous moral philosopher, who worried about the unbridled march of, of, I would say, the scientific method without reflecting hard about what science was trying to do, and, and whether it was accounting sufficiently for a full range of, of human experience, and whether or not in some cases we needed strong moral and ethical codes for the science we were undertaking, and actually those questions are every bit as important now. And I think that was very helpful to me. She really got me to think about the, the limits and how we might sometimes need to ask ethical questions about the work we do, and that's very much the case at the moment with areas such as artificial intelligence.

[11:26]
Mm. So, in '78, you had obtained a First Class Honours degree at the University of Newcastle. You've already mentioned you went on to Edinburgh to do your PhD. And the subject matter there, as I understand it, was understanding how the human dialogue is organised.

Mm. Mm.

Can you just say a few more words on, on that subject?

Well I, I was very lucky. I went into a programme, a PhD programme, that, I mean nowadays we, we try and consciously build more PhD programmes like this, but this was one of a very few at the time it existed. It was a programme called Epistemics. I

was in the School of Epistemics. But what it was, it was an interaction, or a collaboration, between different departments, artificial intelligence, linguistics, psychology and philosophy. And, basically, around the whole question, the kind of questions we've been talking about, but they had different approaches. And, you got taught in your first year the very different approaches to asking questions about, you know, how does human, how does the human mind work, whether you're a psychologist, or whether you're trying to write a program to understand language, or whether you're a structural linguist, or whether you're interested in the philosophy, how language works philosophically. Very different approaches. And so, that first year, you have a lot of options, and in fact, a number of us working on that programme settled on our final areas of study quite late. And, I look back, I look back on that. And we were also, you know, we, nowadays our PhD and DPhil students are expected to kind of, start, finish and complete within three years. It was quite unusual to do that back in the day. You often found yourself expected to be writing up and carrying on into a fourth and even a fifth year, and supporting yourself through bits of teaching for the rest of it. So, the idea, you would spend a year, a year being taught these different courses and then get into your research question. So I thought about a number of areas, and one of them, and actually, looked at the possibility of doing work on modelling, the acquisition of particular skills in young children. So that would have inspired computer modelling by psychology.

Mhm.

But in the end settled on, on language and language structure and understanding, and in particular how dialogue or conversation is organised. And, yes, it was a mix really of, again I think influences. You were very influenced by the people you worked with, you know, so, in this area, computational linguists and linguists working at Edinburgh, we and a very strong tradition in this area. People like Professor Gillian Brown, who was trying to understand how humans learnt to organise and, take part in, in dialogue.

Mhm.

And, and we, it was really a mix of the empirical studies and trying to see what actual people did when they were, particularly trying to engage in, in tasks that allowed them, required them to kind of share information of a particular sort, how they structured their conversation, and could you build essentially a model or a computer program to do the same?

[14:29]
Mhm. So, after, I say after Edinburgh, were you still writing your PhD, or your thesis after you left Edinburgh?

Oh indeed I was. [laughs]

I rather gathered that from the earlier conversation.

Yeah. Yeah, well... It rather haunted me.

Yes.

No, because, I think, again… I mean, I've noticed that, I've been quite lucky in some respects. When we arrived at Edinburgh, believe it or not, particularly in the current context, there was a very real prospect, in 1978, that they were going to close the Department of Artificial Intelligence. There had been a report by Sir James Lighthill, who had looked at this whole area of robotics and AI and concluded that it had no future. And so these were quite tough times. It turned out, in the course of the next few years, and people fought for the department to continue, and, brilliant, it's now, you know, it has always been one of the great departments in the world for this work. And, they, they were saved by the fact that actually, the Japanese, in the early Eighties, began to see artificial intelligence as a way of, of securing their economic advantage, you know, building intelligent robots, and, it sounds quite familiar, that's exactly what people are talking about now. And people worried back then that the Japanese might gain this huge advantage, so programs of research were started in both the US and in Europe and the UK, to set their own programmes of work up. And there was a flowering generally of interest in, in AI, and an area called cognitive science, which is the kind of, mix of psychology and linguistics and AI. And at the

time, as I was coming to the end of my PhD funding, there were lectureships being offered, and, one of them was at Newcastle University. It was actually in the Department of Psychology, and it was to advertise the cognitive science lectureship. And they were interested in people who had a background in AI.

Mm.

And historically, AI has tended to thrive either in engineering or computer science departments, or else in psychology departments. And at the time, at that time, in the Eighties, that's what was happening at Nottingham.

[16:40]
Right. OK. Yes, so you, you moved to, you moved to Nottingham.

Without my PhD, actually written…

Without your PhD.

Well of course, it was only going to be a few months of course, I, I assured myself. And, it was a year and a bit later that it finally got handed in. [laughs]

Yes. And so, how long were you at Nottingham for?

Well, I was there for, a good length of time actually, fifteen, sixteen years, and, I left in 1999. And, that was a really, a really interesting time, and very, very… very fruitful I think. At that time my research was very much around the area, AI was called knowledge engineering or expert systems, and in fact the British Computer Society had a specialist group that ran expert system conferences very successfully during this time. And, the thought was that, to really build expert decision support systems, or expert systems, systems that were capable in an area of human expertise, you had to study the human experts. How would you structure the knowledge, how do you get the knowledge out of experts, how do you code it in programs, and, build appropriate interfaces to such systems? And this was a, a large part of the, the work during that time were addressing those sorts of questions. And it was a core part of a

lot of the funding in those days, was to build these decision support systems, and, many of them very successfully deployed. Many of them still in use in various, you know, revised forms, no doubt about that. And having the company of psychologists meant, who were doing, really doing deep work on how humans process information, how they made decisions, how you can construct an effective experiment to see what method would work over another, was extremely valuable in, in my work. And, they allowed me the capacity, the department, to, to set up an artificial group within the department that had, well, a range of interests, a number of members of staff, and we were also teaching joint degrees in psychology and artificial intelligence, which was very exciting.

[18:53]
Mhm. And, I know during that time, first you were considered a, a Reader, I understand, and, a Reader in intelligent system.

Mm.

And later Professor.

Mm.

Can you tell me, for our listeners, a little bit about that award, and that role per se, and…?

Well again, I think I was, I was fortunate, the head of department at the time in Nottingham, Professor Ian Howarth, was a psychologist, he, he had always had an interest in, in artificial intelligence, and saw… And the whole area of how you understand and how you can model intelligent behaviour and where you draw your inspiration from has had a number of, of ways of being referred to over the years, intelligent systems research, artificial intelligence, cognitive emulation, lots of different ways. But the basic idea is, we are an existence proof of a system that knows how to solve problems, does it pretty effectively in many contexts. Can you build systems off those bases? And, you know, many our systems that we did build were blends of inspiration from human problem solving, and exploiting the raw power

of, of algorithms and engineering in a way that didn't necessarily stick to how we know people solve problems. And, at the time, as I was progressing through my career and securing various forms of grants and grant-supporting, building the group, one… Ian Howarth had brought to the attention of a, of a donor to the university, Allen Standen, who was actually in construction, the opportunities – and made his money in construction – the opportunities of funding a post in this emerging area of intelligent systems. And so, initially the money was there to help support the group, and, and my advancement to a Reader, which is kind of, between a lecturer and a professor, and sometimes called an associate professor nowadays, and then on to a full professorship. And I was lucky to secure that relatively early in my career, I think I was, about 36 or so.

[21:09]
And from your, during your, early part of your, I say academic career, you were involved in, funding, or, or obtaining funding, I know certainly, the latter part I know has been associated with obtaining funding for specific projects, and, but, is that something that came about as early as your time at Nottingham?

Yeah, well, I mean I think, again, sometimes this, you know, you can be in the right place at the right time, and I think that, in the whole area of funding for artificial intelligence and, the kind of work I do, there have been periods in which funding has just, has been substantially made available. There was the, the programme I talked about that we put together to confront the fifth-generation Japanese system was called the Alvi[ph] Programme[cap?], and that was a source of funding in the early days. The Research Councils in the UK have always been extremely supportive, and so the Engineering and Physical Sciences Research Council, EPSRC, funds computer science, has done over the years. It's changed its name, it used to be the Science Research Council, and it was the Science and Engineering Research Council, and now it's the Engineering and Physical Sciences Research Council. So, it's morphed through, but actually, it has always been a major source of funding for, for, for research in, in computing and advanced computing, and many other areas. Essential source of, of funding for innovation in this country. But there was also available EU funding, and that became an important source of funding, from the European Union, back in the early Nineties, receiving funding for what was called the ESPRIT

programme. And, that allowed us to work with colleagues across Europe in some really exciting ground-breaking work in, in building knowledge engineering tools and systems.

[23:07]
I know you're involved with so much, but if we took Nottingham as a block of time…

Mm.

If I said to you, what particularly would you like to be remembered for, or achievement you are particularly proud of from that period of time, could you put your finger on one?

Well I was, I was, I was… I was pleased with the fact that we, we established courses in artificial intelligence and cognitive science. We really tried to bridge the disciplinary divide between psychology and computing science and other subjects. So we graduated students with degrees in these who have gone on to do really interesting work. So, you're very proud of the students who, who you've, who you've worked with and taught and researched with. But I, I guess I'm also proud of the fact that, that we did manage to do a lot of significant applied work, you know, our work… I always feel that research works best when a theory kind of, comes up against the brute force of reality, or that you bruise your toe on reality. You have this idea, you try and build a system, you put it out there, and for various reasons it, it doesn't quite work the way you thought, or… And that just improves your own understanding and helps extend the methods. So, in that work, in that period, also I, I had worked a lot with industrial and consulting companies, so one in particular in the early days was Cambridge Consultants down on the Science Park in Cambridge. And we… And they had an AI group there, and we had a whole range of interesting work. And, so I had, I had always thought that that, that was, that was an interesting interface. And so I'm quite proud of, of the actual systems we built and deployed, and some of these were in defence contexts, some of them were in financial contexts. One was even in the area of brewing. And one which was my first, if you like, commercial spin-off was a company that was supported again by the Research Council, so-called Teaching Companies Scheme, where you could take some ideas from within a university, and

get funding to build them into working with a company into a, into a new company product. And so, in the Nineties, late Eighties and Nineties, I was involved, actually with colleagues in the Department of Chemical Engineering, and the AI challenge we sold was to take a diagram of chemical process, which looks a lot like a, a logic diagram, and turn it into a three-dimensional designed chemical plant. And, that was sold eventually to, to an American corporation, AspenTech, and is, some of that software is still, quite a substantial amount of it, is still powering software in that company in the US. And so that gave me a sense that you could take advanced ideas in computing and translate them really quite quickly into application.

[26:07]
Mm. One of the things you mentioned was, how proud to see your, your students develop. And, albeit we're just talking about Nottingham, it would be interesting, how your, your approach to assisting students in their journey, i.e. in their development, and, perhaps at Nottingham, and how that's developed over the years subsequently at Southampton and Oxford. Has your approach changed? I suppose firstly, what is your approach, and secondly, if you can talk me through how that may have developed.

I don't think there's any, any especial approach, that, that other people wouldn't recognise. I think one thing that we all do sense is that, if you can convey the passion and excitement of a subject, that enthusiasm for a subject, that is hugely important and it carries you a long way. I mean I often say when people think about what they might choose to study at university, or, take as a course, do something that excites you. And, and we're all differently excited by different things. It doesn't mean that there's a particular necessity to study X and Y. I'm a big believer in doing what excites you, and doing what you find rewarding. And that will be different for different people. But where you have students who in some sense come into a subject, and many of our psychology undergraduates would come in, they'd be rather surprised to find themselves in a lecture being taught programming for artificial intelligence, and… But actually, what you can convey I think is the sense of, why this is exciting, what this is a tradition leading to. And I think through time, the excitement of AI has become increasingly palpable as we've seen more and more extraordinary landmark results. So, passion, enthusiasm. Not being in any sense,

unrealistic about how hard the work is going to be. It's, it's, it's hard work, there's a lot to, to master. There's a substantial amount of fundamental skills and capability and knowledge to acquire. It isn't just, something that can happen immediately. And, for some people this comes easier than others. And so working out how you support a whole range of interesting capabilities is important. When it comes to kind of, building research groups, I have to say, I've tended to work on the simple maxim that, try and hire people, the best people, and, [laughs] try and hire people who are cleverer than you. [laughs] Yes, it's about… And, and that's a… Yeah.

Yes. I think, a few successful entrepreneurs have the same idea as well.

Mm.

[29:02]
And in 2000 you move from a land-locked Nottingham to the, to the south coast.

I did, yes indeed. Yes indeed. Well that was a, that was very interesting. Of course, you know, this is, you don't do any of this in isolation. So, you know, you're, you're really there, you know, with a family, and, commitments, a wife who has always been fantastically supportive, and, and had her own career in Nottingham. But we took a view that, at that point, we had been at Nottingham for a good amount of time. There was this really interesting opportunity of a, of an appointment at Southampton. And Southampton was different in the sense that it was going to be an appointment in a department of electronics and computer science. So it was, having spent a number of happy years in the company of psychologists, the feeling I had was that, if I had a critical mass of engineers as well to interact with, that would be a very good next stage. And also, they had a very significant interest and experience in, in both Internet and Web technologies. And, for many years my interest in AI, we had gradually become aware of the power of distributed systems, and, I think we all perhaps remember the first time we, we used the Web, and in the Nineties I was becoming experienced of this. I had PhD students also working on trying to see what opportunities were available to put intelligence into the Web, or intelligent algorithms on the nodes in, in the Web architecture, what could that do? And, and Southampton

just seemed to offer, offer that real capability. And, it was on the coast, and, I think we all thought that would rather a nice place to, to be living.

[30:55]

Mhm. And is that where you homed in on your Semantic Web research?

It was really, yah. So, it was kind of a natural transition in a way, because, the stuff on knowledge-based systems, or intelligent systems, was, actually, I'd say in the Eighties and Nineties, largely conducted with the idea you try to build the system in a box, you know, and the connectivity was not a… The idea of a network effect between lots and lots of connected expert systems was, was not, was not a major area of concern. There was an area called distributed artificial intelligence, but it wasn't in a sense looking at quite the same, in the same way that we then came to see the Web. As the Web became viral, and massive, and everywhere, connecting hundreds of millions and then billions of individuals, with huge amounts of computing resource, you began to imagine that, what would happen if you could treat aspects of the data at each of the nodes in the Web graph as kind of a distributed database. Or what if you could treat users of the Web as a, as, as assisted agents in, in doing various forms of intelligent problem-solving. So, the Web as a kind of distributed knowledge-based system, what would that even mean? And the Semantic Web was trying to build technologies to support parts of that idea. So the idea that you could take a, a page of content, and we all think of content in terms of, perhaps the layout and the fonts used, and where the pictures are, and what the colours of the paragraphs are, but if you could take the code behind that, and actually point out to the computers, and the programs using it, that this heading is actually the name of a particular conference, or this particular part of the text is referring to a speaker at a conference, or, over here we've got a reference to a, to a paper, because it's in a set of, a list of papers at a conference, you know, the kind of things we typically see as humans when we read a Web page, we understand what its layout is telling us semantically what it means, what it's about, what could we come up with, languages and protocols to describe content in that way, and then have our machines exploited. And that was essentially the idea behind the Semantic Web. And, that's where Tim Berners-Lee and I first began our work together.

[33:17]

Mhm. And, one of the projects I believe that you were involved in at one, very much involved with, was the AKT project at Southampton.

Mm.

I know it's multimillion-pound, and involved other universities as well. So perhaps you could tell us more.

Well it did involve a lot of universities. And it was… Again, I mean, a reason that I found myself at, at Southampton, was also, the leader of the, the group that I then joined was Wendy Hall, Professor Dame Wendy Hall, who is a, you know, a luminary in the whole area of, of Web and Internet science. And, and so, at the time, I was very kind of, keen to join her group, a number of us did at the time, and, and we were thinking about putting this large project together. In fact at the time, when I was at Nottingham, I was imagining that I'd be involved in leading this project from Nottingham and that Southampton will be involved, and the Open University would be involved, and Sheffield would be involved, and Aberdeen would be involved. So we had this kind of idea of a, of a – Edinburgh would be involved, a multi-site university collaboration. When I moved, with some of my group members, to, to Southampton, we configured it, but it was still essentially, a number of universities, around the idea of AKT, or AKT [pronounced 'act'], stands for Advanced Knowledge Technologies, you know, how could you put the idea of intelligent, AI components into the Web at scale, what would that look like?

Mhm.

And so that was very exciting. We, we built some of the, the first demonstrations of what is now kind of, pretty well understood technology, how you could calculate social networks for example between scientists and engineers who were publishing their material on the Web, what would that network or community in practice look like, and could you provide tools to identify them? Could you provide tools that could automatically analyse papers online, and find out what they were about, and, if you took thousands and thousands of papers, could you work out what the new themes

were that were emerging from them? So, these kinds of ideas that, technologies that dealt with the Web as a distributive knowledge resource, this was the excitement.

[35:45]
Mm. And, looking at the commercial side of, of your work at that time, this is when you were involved in the formation of the company Garlik.

Yes.

Yes. And, for our listeners, Garlik spelt g-a-r-l-i-k.

Mhm.

Based on your Semantic Web research. Perhaps you can talk us through your journey with Garlik.

Well that was, again, it was, it was partly, I suppose, a lesson born out of other start-ups I had been involved with. It was a… It, it built on the idea of, people's personal information in some sense being at risk of being disclosed, unintentionally or intentionally, on the Web, and how that might compromise your, well, effectively identity theft.

Mhm.

The challenge ofidentity theft. And it was a, in the early 2000s this was an increasingly, people were increasingly concerned about this; as more and more of your personal information was on the Web, how could you guard and maintain it? So Garlik was thought of as a, as a product that could actually spot and alert users to, to this possibility. Now we're very aware of this as a, as a challenge nowadays. At the time, we sought to build products and services off the back of some of our core developments in the, in that project, in particular ways of storing and representing information, called graph databases. We built some of the earliest graph databases using sematic technology ideas, and we used some of the ideas we had been developing to harvest and look for sensitive information on the Web, and put this set

of techniques together. And I should say that the, the interesting thing about the project was also that, I was approached by people who had the idea of looking to exploit this technology for a business end, so it was driven by a business problem. And, Tom Ilube was its CEO, and, the chairman of the company was Mike Harris. They had been involved in setting up Egg, the bank, the online bank. And, they had a lot of managerial experience. And I took some of my, the research, researchers, and some of the open source software that we had developed, and looked to redevelop that into these products and services. And, I think, in about six years, six years really from, from idea to ultimately an acquisition by Experian, for, yeah, a, a, a good amount. And all I can say about that experience is that, it was, it also showed you that, sometimes you can… It's often the case with academic research, or any research, that you can believe that the market wants one solution, that it actually wants a lightly different one. So that, you have to be prepared also to modify what aspects of your technology you think will really make the difference in your, in your product. And, and Garlik is still alive and well as a, as a component of Experian's offer. And, along the way we, yeah we, the system was recognised I think quite widely by, by the technology development community.

[39:14]
Mhm. I mean, the product today, I know from searches, is DataPatrol.

That's right. That's right.

And was that the name of it at the time, at the time you…?

It was indeed. It was indeed, yeah. Yeah it was. Yes it was. Yeah.

And, you say recognised. I think you're being, well, very modest. So, Garlik was awarded the Technology Pioneer status by the Davos World Economic Forum, and, I also understand you won the UK national BT Flagship IT Award in 2009.

It did.

So you must have been…

It was very… It was exciting times.

[39:48]

Yes. Yes. And then, just taking Garlik to, finish up your involvement with, with Garlik. Acquired by Experian in 2011. And at that stage the business had grown quite considerably financially, hadn't it.

Yes. And we had, we had, you know, we had well over half a million users at that point, and so it was a, it was a, it was a really interesting point to be. And I think that, I think the other thing is that you, you recognise at some point, you know, there's a, there's the next challenge as well. I mean I, I've never been in a position where I've thought, well I really want to go and be a full-time commercial CTO for example, or a, or a… So that, I've always been kind of, really brought back to the, to the academic research. And again, partly because I don't have a single set of AI interests, so I, I, we've stressed here the work on the Semantic Web and knowledge engineering, expert systems, but another thread of my interest has always been around actually looking in detail at how the human nervous system works, and, building what we might think of as biologically inspired neural networks, or biologically inspired robotics. And so, over the years, having published and worked with people in that area, right back to building simple robot simulations of ants and other simple organisms with my colleague Dr Barbara Webb at Nottingham. So… And that really did inspire students, they… It's now quite commonplace to imagine building these Lego models that kind of follow the light, or, implement some basic biological mechanism. But back in the Nineties, this was, this, this was, this was difficult to do. And we were writing both the course and the codes to actually do this kind of work, yeah.

[41:40]

And during those Garlik years, in 2006 you, as I mentioned in my introduction, became a Fellow of the Royal Academy of Engineering.

Mm.

Now, at the same time well we've talked about, a little about collaboration with other universities. I understand you were involved in a collaboration and the formation of the Web Science Trust.

Mm.

Again, a founding member with Sir Tim Berners-Lee, Dame Wendy Hall, and Daniel Weitzner.

And Jim Hendler.

And Jim Hendler. Yes.

[laughs] Indeed, yes. Yes.

So, perhaps you can talk a little bit about the Web Science Trust, its objectives, and achievements.

Well that, that was, that was a really interesting, I suppose realisation on behalf of a number of us that… I mean when we had been working together with, with, between, particularly between Southampton and MIT, we had been doing a lot of work together, and we realised that, whenever we were building engineering solutions in the Semantic Web arena, and this should not be at all surprising for somebody who has spent years in a psychology department, but you know, you do recognise that the human element, the thing that was the prime determinant of whether a system would succeed or fail; yes, there was the technology component, but so much of it was around the, the sociotechnical. It was around regulation, it was around how humans did or didn't take to the technology, how they were incentivised. It was around, sometimes aspects to do with the, with the, with the economics, the raw economics of the situation.

Mhm.

So, Web Science was a recognition that, the Web had become so large and such a significant part of our world, that it was worthy a subject in its own right, in the same way that we have a subject we call climate science, or environmental science, that, the importance of this, this system or set of systems, is such that it's an object of study that one needs to think about, and you need to think about the methods you'll develop to investigate it. And in looking at the Web, it isn't just the engineering protocols you've got to worry about; of course it's the, it's the network effects, it's how ideas move across the Web. And so, back in 2006 we were really using it as a, Web Science as a, a rallying cry to say, we've got to have this broad mix of disciplines contributing to understanding the impact of the Web. Now, this looks pretty straightforward nowadays, or pretty obvious to people when we look at the impact of the Web and the things we worry about, everything from fake news to, to the, the danger of, radicalisation, of, of people using the Web, or the impact of the Web on people's attention, or, the distraction and so on. But, it needs saying. And I think, a number of us, and my own background and interest in multidisciplinary, interdisciplinary studies, it seemed we had to re-state the fact that in our courses, it's very easy in a computer science course, or a degree course, to go through three, four years of study, and not be exposed to fundamental insights, whether it was from behavioural economics, or whether it was from psychology, or the law, that make you realise that your system's going to be deployed in a very complicated situation, and you need to have other tools and methods than just the ones that computer science would naturally draw on. So Web Science was about bringing those elements together, bringing researchers together from across disciplines, to focus on problems that we all recognise as being essential in understanding how the Web has got to where it is and where it might be going.

[15:39]

Mm. And today, the Web Science Trust has laboratories throughout the world.

Yes it does, and it's a, it's really acting as a convening, a convening focus, a convening force really for, for researchers, and for those who are interested in these questions. And it's not to say that, you know, it'll become a, a separate and distinct discipline for ever and a day, but it was to act as a way of drawing attention to these big questions that need to be resolved. And I think, laboratories and researchers find

it really quite helpful to, to kind of have a way to give themselves permission to kind of collaborate. And, actually, this is, you know, increasingly common, it's… And it was never that it never happened, but we kind of felt that we were able to kind of act as a bit of a catalyst.

[46:30]
And so we're talking about November… Sorry, we're talking about 2006. But in November you became President of the BCS, the British Computer Society. So, perhaps you could talk to us about your involvement with BCS,, and when you joined, and, your time up to, to President and afterwards.

Well again it's interesting. I remember, I first got involved in BCS activities actually through the Expert Systems Special Interest Group. So that was back in the, the, the Eighties.

Yup.

And, so, had always been involved, if you like, in that specialist group role, and had even helped to organise Expert System conferences in the, before, before 2000, in the Eighties and Nineties. And that helped us bring together lots of interesting and fascinating work in, in that field. But the BCS, if you like, centrally, the central organisation, again I think I have to kind of, lay some of the responsibility at Wendy Hall's door. She was interested when I, I moved to Southampton and said I ought to get involved, and there was a, a need for people with my kind of background to help the BCS in what it was trying to achieve. And so, I found myself getting involved, and, through that process, pretty quickly on the, on the Board of Trustees, and then, over time finding yourself in that kind of, [laughs] inevitable kind of, succession route into, into being President. I didn't anticipate that I would be President in its fiftieth year, which was particularly exciting actually.

Mhm.

But, again, the BCS as an organisation, where it was trying to both promote in a sense computer science as a professional, as a profession, you know, one that, in that sense,

was both profoundly important to the economy but also society, and what did it mean to, to appropriately qualify individuals or audit courses, or, organise, you know, both, both the academic and the commercial side of the IT, IT field. So interestingly, BCS has always been both a, a learner society in some sense and a professional body. And, that was very interesting.

[48:58]

Mhm. Now I know with most presidents of the BCS they have a theme of their year. [NS laughs] And I understand yours was, involved a public engagement.

Yes.

And, perhaps at that time IT didn't have the best of reputations, world at large, with a number of high profile IT failures.

[laughs] That was true.

And I believe that's one of the areas that you looked in your year to redress or, or the record straight.

Well… [laughs]

Put the record straight, if that's correct.

I mean I was, I mean, there was, there were lots of efforts by, by my predecessors and successors in this area. So, I mean the BCS is, is great, because there's just a, a lot, an ongoing and a longstanding commitment to these challenges. I think, you know, again, for lots of reasons IT had a, had a rather bad press, and people would focus on the largescale failures, but would never focus on the huge amount of IT that was routinely keeping everything from the lights running to the, to the banks kind of, churning out cash at the cash machines. I mean so many aspects of our infra structure are down to complex and, and well-engineered IT systems. But there are also areas of pretty poor practice. And so the thought was, that, you know, there had to be, that had to be gripped, and we had to understand how we could improve things. The issue

around public engagement was more around worrying about the, the supply of bright young minds into the profession, and also, trying to battle against the idea that, that computer science was just about geeks in basements, and, and usually male geeks in basements. So we have had a real challenge, and it's still ongoing I think, about, persuading people that, that computing is, can broad and inclusive, diverse. It is exciting. It can't just be about, the pure technical aspects of the profession. It's about how you understand embedding systems into human affairs. And so there's huge scope for, for other allied disciplines. And, that, I remember very much in that year, it was very much about, you know, there appeared to be actually quite a crisis in terms of university recruitment of graduates. And, over the years this has waxed and waned, and people worry about different aspects of that. I did work for the Government on employability and computer science graduates recently. So, there are always issues in something that's as important and as significant as computer science in our society. Back then it was also about trying to get just a better, a better appreciation of why it was exciting, and, I think AI has always been actually one of the secret weapons on this, because people are just drawn to it. I mean sometimes in a sense of fear and loathing, and sometimes… And again, putting that right, getting people to understand where the genuine concerns might be, and where the huge benefits of this are, it is genuinely exciting.

[52:18]
Mhm. I believe, I picked up a quote that you made at the time, which I think sums up to me your comments, 'IT for all.'

Yes, indeed. And, it was a… It was, it was a year in which there was, there was much to celebrate. I remember the privilege of talking to Sir Maurice Wilkes, who was the founding president, a founder, he, he gave some very sage and sound advice. He was a great one for kind of, arguing against feature bloat and felt that far too many programs had far too many features that nobody cared about. [laughs] And I was kind of, rather impressed, that was a rather wise observation. I remember going down to Bletchley Park for the opening of the, of a the bombe rebuild, and that was a meeting again of the remarkable people involved in that, including the, the female operators who were so essential to, to the allied war effort there. It was really exciting. Yeah.

Yes. They're absolutely incredible people, and…

Yes. Absolutely. They are inspirational.

Absolutely. And, it's… Yes, I… Fantastic. Both you and I have had… Well, it's an honour to have had the opportunity to, to meet people involved at Bletchley Park.
[53:34]
So, 2007, 2011, that's the time that you've been promoted. You were Deputy Head I believe of the Electronics and Computer Science at that juncture in time. In 2008, for those who have got Amazon accounts, that's one of the books that you, you can access. [NS laughs] Now, The Spy in the Coffee Machine, Amazon here, 'a very engaging treatment of challenges to privacies in the Internet age.' Now, perhaps you can tell us a little bit about that, that book, which was certainly very well received.

Well, I, I think… I mean I, my co-author, Kieron O'Hara, and, Kieron had been working with me in my AI group at Nottingham and came down with me to Southampton. So, I've had a, a fantastic and long working relationship with Kieron, and… Kieron came from a philosophical background. But we had increasingly, we had increasingly become kind of, aware of the… Well you can't not. I mean one of the extraordinary challenges in our field, and we often, I often refer to as the exponents of change, you know, the, the fact that computer power is doubling every fifteen months or so, and every capacity, well, about the same timescale, and the sheer explosion of devices, the Internet of Things we now call it, does get you to thinking about, what our notions of privacy and autonomy amount to. And, *The Spy in the Coffee Machine* was this, you know, rather interesting idea, which is now more true that we could ever imagine, that devices in your home might in some sense be capable of keeping an eye on you.

Mhm

And in fact, it was partly, you know, Cambridge University, the Department of Computer Science, had an Internet address, probably one of the earliest ones for its 'coffee machine'. And, [laughs] we were taking the idea from that. You know,

camera by the coffee machine. What do you pick up, as people come and, have their cups of coffee and hang around and have a chat? So the whole notion of *The Spy in the Coffee Machine* was to kind of talk about the nature of what we might see in a society that was completely, pervasively shot through with computing devices and information capture devices. And many of the things we talk about in the book, I mean we, we imagined them as, as possibilities, you know, a couple of decades, but, they're here now. I mean, so everything from, devices in your home that can actually talk to you, and, possibly surveil you, to, the information that would be being passed to third parties you may or may not know about from your mobile phone, and, what can we reasonably expect by way of our common consensus of what it is to lead a, a private life? And, that's always been a challenge. Some people think it's a lost cause and you have to get over it. And people will often tell me that, you know, kids in the modern age don't worry about privacy, just look at all the information they share. My experience is that as they great up they, they increasingly get to care. And that we all have a sense that just because you can record this stuff, and you do have access to it, doesn't mean it should be used against you. And… So, I mean I think many of the ideas in *The Spy in the Coffee Machine*, we look back now and say, wow, that happened quick. And I think the, the questions we were posing were, how do you, how do you as a society balance the legitimate interests of, for example, law enforcement, with an overriding capability to be a big brother state. How do you balance an individual consumer's interests against the massive capability of a big platform, like an Amazon or an Alibaba, in collecting all the information it does, and what it knows about us based on our patterns, and, everything through to the device that you wear that monitors your sleep, and can monitor everything else you may or may not be doing.

Mhm.

Yep.

[57:54]
And, I know you, you've authored and been involved in over 500 publications in your, in your career, but, ten years on from The Spy in the Coffee Machine, I'd be interested

in when we can expect the sequel. [NS laughs] Or, or are there any intentions to update it? It was, it was, the book was deemed very relevant then.

Yah.

Readable from, if you like, non-techies or non-geeks or whatever. And I, and I'm must thinking, what we're seeing in the press even today and yesterday, whatever, is, as you said, it's, it's as relevant today as it was in 2008. I just wondered if you had any plans to revisit it, and, produce an updated version for the masses as it were.

Well I'm not sure. I mean Kieron and I, we must have that conversation. I think, I think, things have, have moved on, and, there is still a need to write about this. And actually, there is a book in the pipeline, just delivered, but it's about the digital ape. [laughs]

Right, OK. Yes. You've moved away from the coffee machine.

Well… Which, which is, again, to understand, you know, what's, what's it like being a human in the twenty-first century, you know, and how different is that, and, of course, you know, perhaps he does have a role on that. So, yeah, I hope, I hope that gets as well reviewed. [laughs]

[59:24]
Mm. Great. And, we're talking about, I say, privacy, but, surrounding data, but it was in 2009, then Prime Minister Gordon Brown appointed yourself, along with Sir Tim, Sir Tim Berners-Lee, as Information Adviser for the UK Government. Perhaps you can talk about that, and, and how that led on to data.gov.uk, which is I'm sure a site most of the listeners will be aware of.

Well that, again, speaks to a mix of serendipity and, and foresight on behalf of some people. Because… Well, where to start? Tim and I had been working together on this AKT project actually. I had been working also with a part of Government, a little known part of Government but a really interesting one, called the Office of Public Sector Information. And this was in 2006 or so. We had been, we had been doing

this work where they had asked… In fact, a very interesting, the Civil Service had, had become aware of our work, and… Just pause.

[pause in recording]

So the work on Open Data has a, has an interesting history. So before Gordon Brown appointed Tim and myself, I had been working with a, a little known part of Government called the Office of Public Sector Information, and they were charged with… Actually it's a European, was a European directive, to kind of make public information, the information that Government collects, more widely available. Not information about people, but information about, you know, all sorts of, public service issues, like, where the hospitals are, or, where the train stations are, or, all sorts of public data, you know. Where there's statistics, whatever it might be. And different countries have very different rules about whether this data is a) available and b) whether you have to pay for it, right down to whether your maps are available openly as open data. So, this work was commissioned by, by two civil servants actually who, who had heard of our work in AKT, in the Advanced Knowledge Technologies, and had heard about this stuff in the Semantic Web, and said, I wonder if that method, those ideas, would help us link all this data that's laying across, government, local government, arm's length bodies, organisations like the National Health, or like the Ordnance Survey who manage our maps, and so on. What would it be like if we could bring this information together, in just the way we imagined. So, Carol Tullo, who at the time was the, gloried under the kind of title of Her Majesty's Printer, was head of this office, and she had a civil servant, John Sheridan, who came to see me. And I then started to work with them on this project of using technologies like the Semantic Web to integrate public sector information, and publish it back. We had some great examples to show, and the work was actually published in a report to Parliament in about, 2007 or so. And, we wrote an interesting research paper. Tim Berners-Lee was aware of this, and there it might have kind of, lain, had it not been for the fact that, Tim was having lunch with Gordon Brown. I mean Tim was the inventor of the Web, gets to have very interesting conversation with, with people, heads of state and… Brown had asked him this very disarming question, you know, what, how can the Web help, what can we do to make best use of the Web? And, Tim said, 'Put your data on it.' And that very simple suggestion evinced the reply, 'OK, let's do it.' And, Tim then gets in touch and says, 'We're going to go to No. 10 and we're going to be talking to them about this making public data public project. And,

it was born from there. We were very lucky, I have to say. Previously, people had
been working on this whole idea, and the power of information in fact, in
Government, you know, what you could do to release information to make it more
widely usable. And, Tom Steinberg for example and others, people like William
Perrin, had been working on this, in Government and around Government, advising
them to, to produce really interesting reports during the time of the Blair government,
and then Brown took this forward on this particular commitment to try and make data
available in machine readable fashion, from a, from a website, data.gov.uk. Now, the
US had been announcing something very similar; in the Obama administration, one of
the first things he did after his inauguration was to actually set up a thing called
data.gov.

[1:04:28]

Anyway. There's nothing like a little bit of a race between nation states to get things
going, and, so we thought, well, we'll get on and do this. And, we had a clear set of
ideas, and a fantastic mandate from the Prime Minister. And, civil servants had got it.
We were also assigned somebody from the Cabinet Office, a great civil servant,
Andrew Stott, who, who absolutely understood what the possibilities were, and was
also tech savvy. And that really helped. And, people who get the technology, and
what the possibilities are in Government, are quite a rare breed, you know, and,
particularly in people who could actually sit down and start coding, quite a rare breed.

Mhm.

And, and so we just had this period where we would be charging around various
departments of state talking to secretaries of state, all sorts of interesting people,
saying, 'Give us your data.' And, sometimes it worked, [laughs] and sometimes it
didn't. But, but by the January we had this launch of a, of a website, and… One of
the things I'm proudest of is that, when it was first launched, it was launched as a, Her
Majesty's Government, Britannic Government's crest, and above it, it said, 'beta'.
[laughs] And this was a piece of software that has been, you know, in perpetual beta,
the idea that it wasn't finished, it was under development, and, and the reason, other
reason is that it was open source software. And people said, 'You can't do that. It
hasn't been checked. It hasn't been procured properly.' Somebody said actually,
when the site launched, it looks like something that a couple of PhD students had

knocked together in a, in six months. And, that was the point. You know, it was rapidly assembled, at a fraction of the price of, of a normally-commissioned software. And of course, because it was written in some very well-tested open source software, the kind of software that underpinned, for example, Wikipedia, it had been subject to all sorts of insider and outsider attack. It was very very robust software. So, yeah, we had about 300 datasets at launch, and then it became 3,000, and now it's 40,000. You know, we're, we're… And the thing that happened about that project is, it survived contact with an Election. You know, it was one of those ideas that actually, seemed to obviously sensible. And there's a lot of back stories about how people became really enthused by this, because of, you know, some stories, some tragic, some inspirational. You know, one was a, an adviser whose friend had been killed in a bicycle accident in London, and he just wondered whether there was a, a map of where all the accidents happened, the blackspots for cycle accidents. And there was such a map, it was in a spreadsheet in the Department of Transport. That got published out. And within a couple of days, a number of days, an app had been built to help you, navigate you around, a way round accident blackspots. And, that sort of data's been transformational. Whether it's been in transport, whether it's been in health, whether it's been in, policing, the availability of non-personal data at scale has been really transformational. And I think, what we're proud of, both Tim and I, is that, in some areas where we've been told, you know, that data couldn't possibly be published, and with the help of, of really inspirational civil servants, and committed ministers, across Government, the UK rapidly found itself in a leadership position. Because Cameron's government was similarly, the coalition government was similarly committed. And, and we're on that journey still.

[1:08:03]

Mhm. Yes, and, under the coalition government , as you say, under Cameron, you became a member of the UK Public Sector Transparency Board, and then in 2011 Chair of the UK Government's midata programme.

Midata [pronounced my-data]. Midata.

Oh, Mi…

Midata.

Sorry.

Yes. Well that, that's an interesting…

That's interesting, yes, because it's… Yes. [laughs] Mi… It's spelt m-i data. Yes. Mm.

No, but, I mean that, that, that history I think is, is interesting, because, again, we were very lucky in those, I say early years, but, from 2009 for, five or so years, to have a succession of ministers who really saw the opportunity in, in open data, you know, that it could actually help drive innovation, improve public services, help around transparency. And you know, the Cabinet Office, we had ministers like, like Frances Maud in the Cameron coalition government, we had, in the, in the previous Labour government we had people like John Denham in local government who, who helped us get hold of, of some of the really important geospatial data. And, I think, as we've gone through this process, I mean you know, we've also had people who got it in science and technology, so people like David Willetts who was our Minister of Science, understood the kind of emancipatory and empowering nature of data at scale. So we… And, and when you have an alignment of, if you like, political will, and technical opportunity, and, and really able individuals on the ground, you, you can really make a difference.

Mm.

[1:09:52]
Yeah. Now midata was kind of a… We think about, we talk often nowadays about this data spectrum, about data that is open, through to data that is closed and private.

Mhm.

And, and sorts of data in between, various forms of shared data where you have very definite rules about who and how you want to share that. Open data isn't about

making everything open, I mean let's just be clear. We respect, have to respect, that key information sets must remain private, both individual stuff about security, national security, and so on. But the, the midata programme was a, was a brainchild of people in, again, in a part of Government who were saying, what if consumers had more control and power over their own information? And, so, we set up a programme to look at the possibility of, of commercial data about us as individuals being made available to ourselves for our own benefit. Now think about this in a utility area like electricity or gas. If you knew a large amount about your consumption patterns, and about what you're being charged for, and about what was available out there on the market, and it was easy to, to kind of, port this information around, it might make switching easier.

Mhm.

Or, if you knew a lot about your, your retail buying habits, and those are, other people around you were available as anonymised data but you could have a sense of what that was, you might be able to put together collective purchasing options where you could get together as a, a group to buy and get…

Yes.

There's very very many reasons to believe that empowering consumers with their information could be a very very important way of driving up, a) the quality of data, getting a more interesting conversation between the supplier and the consumer, and actually, allowing the consumer more power and more influence over what is actually information that, you know, that they've been a large part of in generating. It's about them, it's about their habits, it's about their transactions.

Mm.

That programme got off the ground, and, I think that's very much unfinished business, work in progress. I mean it, it's, it would, I think, be an extraordinarily interesting political ambition, and indeed economic ambition, for a government to get hold of that

and say, what if we took seriously the idea of empowering people with their information? Not just as consumers, but as citizens. And so rather than the, your information is something that gets done to it by other people, you are making much more active decisions about where it goes and how it's used, and, and, and the value coming back from that. And I think that's a genuinely interesting, exciting idea, which, whose time has really yet to come.

[1:12:40]
Mhm. And you, you talked about, as it were, everyone being on the same page. Clearly the Chancellor must have been on the, on the same page in his November 2011 Autumn Statement, where, where you were granted £10 million of funding, yourself and, again, Sir Tim Berners-Lee, to found the Open Data Institute.

Yes indeed. And that, and that was a… Well that was again a, a good example where, the argument was made that, open data was not just about improving public services, or about transparency; that if you made this stuff available, you generate economic activity and economic value. So, the proposition was that, if we could get some public funding, we could set up an organisation which would act as a catalyst for building this, this data ecosystem, the Open Data Institute, which is just on five years old now, has been busy both promoting that, providing advice on policy, undertaking training, generating start-ups, talking to public and private sector organisations about how to publish their data. And, yeah, I have to say, both Tim and I are extraordinarily proud of, of what it's achieved. Has a very, I think, good reputation, and, it's trusted as a, an impartial adviser. It's not of government, it's a company limited by guarantee, so it sits independently, but, any value that it generates is ploughed back into the core mission, which is this whole idea of, of finding the value in data for everyone.

[1:14:23]
Mhm. And, now, back a little bit to academia as it were, 2011-2014, you became head of Web, the Web and Internet Science Group at Southampton, where I understand you had about 140-odd staff working for you, which must have been a, a challenge in itself.

[laughs] Well academics, I mean we're all notoriously difficult to, to coordinate, you know, there's, there's all sorts of phrases like herding cats. But actually, I have to say that, that that was, as in all the academic institutions I've been at, you know, the great thing is that, people are just so willing and able to kind of, contribute their effort and expertise in, in what you're all collectively engaged in. We were all excited about the research agenda, we were all excited about the training and committed to it, committed to it and the education it can provide. You know, the, the famous quote is, you know, education, you know, all that stands between, education is what stands between civilisation and catastrophe. And I think that actually, you do really take that to heart as we kind of think about what, what we're trying to do. So the Web and Internet Science, yeah, Group, that was a… That had evolved from the original group that Wendy Hall had founded, and, she was, she was really kind of, a moving force behind the original group, and then we kind of, made, morphed it into this more, this, this even broader coalition of interests around Web science if you will. And, those researchers and, and staff were working on a huge range of projects, from, Semantic Web technologies through to the latest forms of computer-mediated instruction, massive online open courseware, MOOCs, you know, all sorts of topics.

[1:16:25]

Mhm. Mhm. And, you… That… In 2013, you were knighted for your services to science and engineering.

Yes. [laughs] Well that was a, that was… Yeah, that…

That must have been a great honour.

It was. And you know, like in all these things, you kind of, kind of, can't quite believe it. And… But, it's a… I, I think what I was particularly proud of was the fact that it, it was for services to science and engineering, that it was both of those aspects of my, of my, of my life. I always believed in both the, the scientific and the engineering kind of realisation of insights from science, so that was good. And, you know, it's a, it's a huge honour. It's, it's something where you realise that you've basically, of course, hugely benefited from the, from the contributions and efforts in others, and you, you couldn't, this is not a, you could not do this without huge

amounts of support from those around you. And I think it also, I think it's great that those of us who work in these areas, in computer science, in, in the STEM subjects, you know, in a certain sense are able to, to be viewed as, as recipients, because I think it, it's good for the subject more generally.

Mm.

Yup.

[1:18:02]
And, 2013, you joined the board of the tech start-up State.com.

Yes. Yeah yeah. Well actually, no, adviser. I was an adviser.

An adviser.

Yes indeed, yeah.

Yes.

Well, yah, again, I mean I think throughout this time there have been, there have been start-ups and, and some of them I've been involved in establishing and others that I've been brought in to kind of, help and advise. And that's always been interesting. And, you know, I think, I think in all these things, it's just so interesting to work with founders, with people who are passionate. Again, this was a, a platform founded by two really interesting entrepreneurs. And, I think that that's, again, back to the original point I made about the interface between academia and, and economic activity, you know, business, commerce, government, they just make you think hard about what does and doesn't work, and they present often very interesting research challenges, you know, do you understand why this particular technology has gone utterly viral and in another context, you know, is, is, is more or less, unsuccessful. Yep.

[1:19:23]

Mhm. 2015, it was a move back inland, certainly workwise anyway.

Workwise, yeah. I mean I… [laughs] Indeed. I mean, so the… Yeah, I moved to Oxford. Yes. That was, again, you cannot always know. I mean it wasn't, I suppose, on my bucket list of things to do. It was, it was a, very interesting to get a phone call and be asked to consider applying for, for that role. And I had… And I thought about it, I, I had been at Southampton for, you know, more or less since, well, 2000, and, had been also observing the really interesting emergence of a very broad-based computer science and AI effort across the University of Oxford, not just in the Department of Computer Science but in Information Engineering, in the Oxford Internet Institute, in, in the Division of Medicine. Huge amounts of activity around topics that interested me. So, my thought was, wouldn't that be wonderful if, if, if you were to go into Oxford with a role as a head, we call them heads of house, you know, in this case, I moved to Oxford, I took on the principalship of Jesus College, but also had a, an appointment in the Department of Computer Science as a, Professorial Research Fellow there. And that's just, just been really fascinating as, as a combination. Of course our, our home is, is still of course in Lymington, on the south coast, and it's… So, so we, we get used to the A34. [laughs]

Yes. A bit difficult to sail in Oxford.

Yeah. Well, there is water, but it's… Yeah you need…

Punting is not…

…different boat needed.

[1:21:21]
Yeah, different boat, yes. Yes. Thinking about AI and open data, just a, a few questions perhaps for our listeners perhaps you, you could address. And, although I'm talking about, shall we say, perhaps being negative, negativity, but, the sides of it. So I suppose, with open data, the biggest concern for most individuals would be privacy.

Yup.

*So… And, no doubt in your career and working with, with Government, you, I'm
sure, encountered resistance to disclosure.*

Yes. Yes.

*Perhaps you'd like to say a few words about that. Perhaps, how that was overcome.
You've mentioned the spectrum previously as well, but, perhaps you'd like to talk
about the privacy itself.*

Well… Yah. I mean I think, I think, there are lots of reasons why people might not
want to disclose certain information. And again, it was very helpful at the Open Data
Institute for us to kind of, come up with this idea of the spectrum, from, you know,
open data that anyone can access, through to, to closed data for various reasons,
through to shared variously private information. And I think that, the, the reason
people won't disclose, sometimes, you know, they talk about personal information
officially but actually, it's just because, they… In fact when we were going around
trying to unlock data from Government, Tim and Andrew and I and others, we, we
drew up this list of excuses we would hear as we… You know, we couldn't possibly
release it now because, because because. And some of them will include things like,
you know, it's not good enough. Or, it's, it's, it would be too expensive, or, we'd lose
our revenue. And there's all sorts of reasons. We had a kind of, stock set of
responses to some of this. But the stuff around, would it disclose or reveal personal
information, or, information about an individual, we always took that extraordinarily
seriously. And so, that, you have to be very careful that in opening data you don't in
some sense breach an individual's privacy. So, good examples of this are around
things like, police.uk, which is, which is maps of reported crime, which was a real
breakthrough when all of the constabularies published their reported crime data and
gave you an extraordinary view of what was in a sense being reported where. Now,
certain classes of crime are, are, you know, not disclosed; personal information and
others might well be. And so, we were very mindful that, you know, you would want
to be careful about how that was published and what was published. In other cases,
the worry was that if you had three or four open datasets it would somehow

triangulate you as an individual, I mean like, much as postcode marketing kind of does. I mean so… The other thing to say is that, we kind of, almost live in a world where we've understood that there is now so much information that you can be typed even if not identified. You know, your characteristics can be understood, you're a *Daily Telegraph* reader, or you're a *Guardian* reader, and you live in this leafy suburb or you live in this town.

Mhm.

That starts to set expectations on various, all sorts of various models about this, and whether they're warranted or not, that happens. But the real key is, are you revealing really sensitive personal information about an individual? And that we've always taken extraordinarily seriously. I think that you have to do privacy impact studies. You're obliged to when you do open data releases, to understand whether there's any aspect of personal release that might be problematic. And, and release or not accordingly. Yup. And there are datasets that are not published for that very reason, because they are thought to be too disclosing. In other cases you can make a public interest case that perhaps it should be, and, so issues like, you know, performance outcomes for medical practitioners had been one thing, you know, cause célèbre, and some people think that this has driven up performance in other, in areas, and other people feel quite nervous about it. But actually, in many cases, you can see clear evidence of, of real improvement across the system.

[1:25:26]
Mhm. Another area, some people's concerns with, a loss of jobs.

A loss of jobs. Ah… What kind of jobs would that be? In open data, or AI?

Well, no, I'm, I'm talking about AI.

Oh AI. Oh…

So, if I'm talking about…   real…

Are we talking about AI or open data?   I'm sorry, I was losing track.

Yeah. My fault. So, privacy more on the open data side…

Open data. Yeah. Yeah.

…AI.

Well AI actually also has real privacy kind of, issues. I've talked about the surveillance issues, but also in terms of big data analytics where, where there is a sense in which these systems will make, exquisitely precise at, at making more than an educate guess about who the anonymised individual in the dataset might be. So, we need to worry about that. But… Oh in AI, loss of jobs. Well yeah, again, this is, there are a variety of, [laughs] concerns about AI around, ranging from, you know, the existential threat to humankind's existence, through to loss of jobs. And, what… I, I think, we're already seeing all sorts of interesting arguments around whether actually that's going to turn out to be true, and, what the, what the experience of previous technological disruptions has been in terms of job creation, what has happened to those jobs, you know. So once upon a time there were literally, thousands and thousands of gas pump attendants in American forecourts, and garages. Well not just America, all over the world. And, you know, automatic dispensers and all sorts of automation just, took thousands and thousands of jobs out like that. And where did they go? Well they moved sideways, or they moved into another space. They became attendants in tills. And people then say, well that's just a matter of time, and they'll become automated. But I do feel quite strongly that, the demand and requirement for the sociability and the human in the loop, and the human's ability to generate new service types that require humans, in terms of products and services that we see, or care we deliver and provide, will still provide huge new markets for jobs. And, I quite believe that some areas will see real reductions, substantial reductions, but I'm, I think that's very much in progress, and it'll be interesting to see how we feel about that in ten years' time.

Mm. So, and, I think I'm quoting your words from a previous interview you've given, but, more transition rather than elimination.

Yah, I think so. Yah. Or translocation. Yah, I think's, that, we are often not very good about anticipating the whole new set of professions that might emerge. I mean just think about accountancy for example. People worry that lots of white collar professions will get automated. Well there's going to be a new kind of accountancy that's going to emerge, is emerging, and it's around the audit and accounting that associates with data and datasets, algorithms and how they operate, where, it's going to be a new kind of profession, and it will warrant talk about whether or not a dataset is, is a fair sample, is biased, has been interfered with, whether the algorithm is giving a fair, equitable decision. This is a new kind of certification, and it's one that I think will create a slew of jobs. I mean, watch this space for algorithmic accountants in the future of, data audit in the future.

Perhaps I need to retrain as a, [NS laughs] someone who studied accountancy some, some years ago.

Yeah, well… Mm.

I think life's a question of retaining.

Yes.

[1:29:39]
And finally, to talk about open data. A question, the province of large corporations or states, you know.

Mhm. Well that is a, that again is, is very much a, a coming concern and worry, and people you hear, increasingly worries about, data monopolies, and the issue of incumbents, massive companies which have created extraordinary technology and extraordinary services, but now people are worrying that they're, are they too large, are they, do they have too dominant position? What could we do, what should we do? Are they paying their fair rates into the states in which they operate, you know. And that's, that's a really, I think, important set of questions we're going to have to grapple with, you know, what these very large corporations, what they will need to do

to retain and maintain both public and state confidence in how they operate and what they do. It's not all… I'm not, you know, it's not inconceivable that some of these organisations may be in fact, variously re-engineered. There was a company called Standard Oil once upon a time; there was a company called, a dominant telephone provider in the US. And, things can change. But, I think we're still very much in a stage of understanding, and seeing how that might work, and, whether there is pressure for it. And also for states as well in possession of this technology, they've got to ask themselves some serious questions about how they behave, and I think, we've got this extraordinary situation at the moment of, kind of, undeclared warfare that's occurring at the cyber level between various parts of our world IT apparatus, and, in the past at various points we've taken a view that technology has in some sense to be regulated. And if you take biological or chemical or nuclear technologies in their warfare context, we've, you ask questions about limitation and non-proliferation, and, you are not going to stop technological advancement, but what you might agree to do is to stop wilful attack of one another's civilian infrastructure.

Mm.

Because, sometimes seeing something bad's going to happen, and, you would rather hope that that wouldn't be because they, of a state actor. So again, I can see that this is a world which will start to take shape, in which we ask ourselves, are there treaty obligations we need to enter into?

[1:32:25]
Mm. Yes, I mean, in today's paper, I mean, allegations of antivirus provider Kaspersky…

Yes.

…being compromised in some way.

Yeah. Yeah. And these are very difficult questions for us, because, they are, they are deeply technical, they're very political, and they have deep commercial implications as well. And, we… And things move so fast that, these capabilities, you know, are

around the world at the speed of light. So you kind of have to really, think about how we want to organise our affairs. And also, unlike a lot of the other advanced technical dual-use technology, this can be available to very small, either state actors, or organisations, or, other agents who might wish us harm, you know, these things are copied and reproduced and toolkits are available. So we, we certainly do have to be very vigilant in that respect.

Mhm. And as you say, the efficacy of this becomes very important.

It's… You know, it comes back right, I mean, at the beginning of the conversation about, you know, how I was influenced by, by the moral philosophy and ethics of, of people like Mary Midgley as anything else, and that's because you have to think about the ethics in advance of some of the problems turning up, you know, and that's, I think that some of our best legislation has been when we have sat down and thought about where we could end up, and sought to put in place norms, regulations, conventions, before that arrived. Yah.

[1:34:13]
Mhm. And. And bringing us up to date. Earlier this year you were elected a Fellow of the Royal Society. Another honour.

Well…

And, you're active within the society as well.

Yes. Yeah, well that's, I mean that's a, that is a, a huge honour. And I think it's, it's of course famously, you know, the oldest continuous scientific society in the world, it kind of invented the concept of scientific publication. There is something really spine-tingling about putting your name to the Charter Book. You know, you write, write on this vellum page and you, most of us who join, our biggest worry is, are we going to blot [laughs] our name with ink.

Yes.

But, but you know, you go back through there, and, you know, it's, it's full of an extraordinary cast of characters. Isaac Newton's signature's in there, and Robert Hooke's signature is in there, and, Alan Turing's, and, it's a, you just have this sense of, of this, this sweep of history, and, and the ideas there. And I think the Royal Society, and the Royal Academy, although they're societies, are guardians of something hugely important, and I think that, you know, as I've been thinking about where we find ourselves, both politically and geopolitically, in 2017, the assault on the notion of, of verifiable facts, alternative facts, talks of a post-fact world, no need for experts, I mean, all this arrant nonsense which, anybody in science and engineering knows one thing for sure, the world will find you out. And so if you think that you can actually wish the facts were otherwise when you're designing your aeroplane or your computer program, the world will find you out.

Mhm.

In engineering and science, as someone else once said beautifully, we stand perpetually on the edge of error. We know we could be wrong. And I think, understanding how we error-correct, how we look for and test the actual truth, or falsifiability of an idea, that's a fundamental concept we've got to get back in touch with I think as a society.

[1:36:41]
So Sir Nigel, a highly successful career. If I was to ask you what was your proudest achievement in your career to date, what would it be?

Oh that's very difficult. [laughs] Well, I'm just… Proudest achievement in my career. I'm just, I think I've been very fortunate to be involved in questions and issues that have remained really relevant and important through, through a number of decades. We don't have all the answers. And one thing I would want to say is that AI has not yet, we have no, no sense of what a general theory of AI is going to look like, and we're not going to wake up tomorrow and decide we're irrelevant. There's just so much more that we have to understand about the extraordinary system that powers our thoughts and sense of self. So, proudest? [pause] No, I think, I… I think the, the joy of being surrounded by interesting people, with challenging ideas from different

disciplines, that's one of the really magical aspects of, of an academic life. And I think the other thing I would say is, I'm proud of the fact that whenever possible, you try and line up your carefully curated theories with what actually happens in the real world. So, so try and test your ideas against what the world will tell you.

[1:38:20]

And… Thank you for that. And, if you could have your time again, again as it were, would you do anything differently?

I would go on the stage. [laughs]

You'd go on the stage? Yes.

Give that a go.

Yeah yeah, give that a go. Really, yes [laughs] Yes. Right. So if Andrew Lloyd Webber is listening to this… [both laugh]

No, I mean, time again. Yeah. That's a… It's very interesting, isn't it, that so often I think we look back and think that life is full of contingencies as well, that you, you make plans for it and then, then things happen and you look back and think, well, it has a sense of inevitability when you look back, but it never is. And so I think, keeping a sense of what the, what the options are going forward. And so, imagining there are other things you could be doing and might be doing and might want to do.

Mhm.

Yeah.

So actually, for Andrew Lloyd Webber, please scrub that and put in Mark Knopfler's name. Yes. [both laugh] I hear, I hear Dire Straits might be on the agenda.

Ah, well there's a fabulous composer.

[1:39:22]

Yes. Well thank you Sir Nigel. So coming to the end of our interview now, and… So we've discussed your musical aspiration, perhaps to take up on a, on a further occasion. But, you've now been at Oxford since 2015.

Mm.

As you say, at Jesus College. I just would like to know what aspirations you have for, for your time at Oxford.

Well, it is, it is a fantastic environment. I mean the, the thing that, it's the density of, of great people. The collegiate system wasn't one that I, I was educated in myself, but the fact that there are 38 colleges in Oxford, and, and when people come in, 20,000 students at Oxford, or thereabouts, and, but each year group who come into a college, there are about 100 or so of them, you know, and, they all get to know one another. And they're all working in different disciplines, and, the gender, the diversity, you know, is, is balanced and interesting. And people worry about access to Oxford, but we're working incredibly hard on that. So my ambitions are, you know, to, to help make extraordinary educational possibility available to, to people who, anyone who's got the talent, irrespective of means, you know, that's always been one of the things that Jesus College has been proud of. I mean it was the first all-male college, along with a few of the colleges in that year of 1974, to go co-educational. So, that's, that's, that's in our tradition. And we're also expanding computer science provision within the university. So my, my, my ambitions, I mean obviously, the college is a great place to be, we've got an exciting strategy; we're implementing, we'll be developing a, a new part on the site containing a digital hub where the whole idea is to, to show how computational methods and thinking can, can spread across all disciplines from history to English to modern languages to sociology to, engineering and science, subjects where it's, where it's understood. But there's huge areas of overlap in everything from network analysis to, to image recognition. You've got, fundamental computer science is just that, it fundamentally crosses so many subject areas. So, excited about that. Excited about the, what's happening in the Department of Computer Science. Excited about what's happening in the whole area of, of AI and, and human centre computing in Oxford generally, so, I think… The great thing about

the place also is, a convening place, that people pass through it, they come together, they, they're interested about talking there and being there. So, it may not be by the water but it's a great place to bring people together. So, yeah, lots, lots of exciting opportunities. And, I think the, the subject itself, I mean artificial intelligence, open data… Actually, I was talking to Tim recently, we were reflecting on the fact that, the reason we ended up, you know, spending so much time in open data policy was partly that, it's the raw material for so much of what we want to do in AI and the Semantic Web, and unless you've got access to large amounts of data, in the appropriate format, you can't do, you can't realise the potential of many of the ideas we have for a Semantic Web, or indeed for AI services on the Web. So, yeah, I see those two interests very much running along, as well as, I suspect, an increasing interest in these, these policy issues around, around ethics and around appropriate use of technology. And just ensuring that we can, as I said, get people to understand that, at this time above all, we need to trust ourselves to, to think critically, to be open-minded, to imagine that we might not have all the answers, because that's, that's, that's hugely what's required. So for me, education is one of our critical national assets, and we must really think about putting it to its best use.

[1:43:47]
And, you've alluded to this, and, so beyond Oxford, the, I say, the biggest challenges and opportunities. I know you've been referring to that.

Mm.

But, is there anything you would like to add on that? If I said, the next ten years, where would you say...

In, in our field?

In our field.

Well, it is extraordinary. I mean that's again, when you look back, these rates of change… You know, I, I was giving talks a few years ago where I said, well when I started my PhD back in the day on dialogue structure analysis, to then, and this is a

few years ago, there had been a million-fold increase in the power of computers. Well, you think of any subject where the underlying capability has improved by ten to the sixth a million-fold, new opportunities emerge, and, it can catch us out. I was, I was in the *Guardian* in, 2000, I think, '14 or '13, I was talking about the possibility of a Babel fish, you know, automatic real-time translation of one language to another.

Yes.

Well that was just, kind of, released, a variant of it, the beginnings of real commercially available capability of real-time speech, language translation, just this week, or last week. And so, you can, you can, even when you're in the heart of these rates of change, you can be caught out, surprised, amazed, delighted, slightly made fearful by, by the rates of change. And, I think, what, what's going to happen is, we're going to , notwithstanding some cataclysmic event, we're going to be living in a world that is a mesh of virtual and physical, it will be pervaded with intelligent devices, ambient intelligence as it's so called, you know, where everything has in some sense a data capture analysis capability. And, the services that we choose to provide off the back of that, for good or ill, or for health or leisure, or for work and play, those are going to be remarkable new capabilities. And as a society we've got to think how we put them to the best use, whether it's in elder care, whether it's in education, and whether it's in the defence of the realm, we have to think about those issues now. And I think we're seeing an awakening awareness of that. I think computer science becomes more and more critical, more and more exciting. We've got some challenges in that area though.

[1:46:19]

So I would like to see a much more diverse demographic going into computer science. So I did a review for the Government on employability last year, and seeing what was happening to computer science graduates, and, across the country, and actually the subject does well in terms of, of various forms of diversity, and, you know, people from different ethnic backgrounds do quite well compared to other science disciplines. The area we are really poor at still is, is gender, and, the number of women coming into the subject is a cause of really serious concern. And, we've got to work hard and go back a long way to understand where the roots of that problem are, and where systematically, systems are failing us in providing that capability. You

know, it's not a matter of STEM; you know, women pursue in large numbers careers in, for example, the life sciences, in biology. What do we need to do in computer science actively? And I know this is in the minds of many, but, in my college, we have a balance of gender in subjects, you can see that, in professions you can see that increasingly.

Mhm.

We've got to get to grips with this I think in our own subject, in computer science.

[1:47:58]
Mhm. Thank you. Finally, what advice would you give to someone entering the IT industry today?

Well… [laughs] Be prepared for huge amounts of change. Entering the IT industry, I think, you've got to take a view that, a fundamental understanding of your subject, fundamental in the sense of, knowing some of the basic principles around how to build efficient and effective programs, how to build equitable and effective interfaces, how to deploy reliable and secure services, these go back to some quite deep principles that we can't shy away from you know. That, poor execution of our software engineering leads to structures that are difficult to maintain, possibly susceptible to attack, or, not fit for purpose. And I think, there is such a widespread dependence now on IT that people entering the profession should really think about, putting themselves through an extended and broad range of training, that constant revisiting of the skill set through their professional life is almost inevitable, but, the possibility of what can be achieved with the tools and methods we now have available is really, so very exciting. So I think, my advice is to, is to go where the interesting problems are for you, from, what inspires you as an individual. That's back to the original thought around, study what excites you.

Mhm. Thank you. Well, as you know Sir Nigel, the objectives of Archives of IT is to capture the past and inspire the future. Thank you for sharing some of your past. We couldn't do it justice, all the areas that you've been in throughout your, your career, but thanks for sharing with us today. I think with the passion that's been expressed,

your obvious passion for a number of subject matters, I hope, and I'm sure, it will inspire others in the future. Thank you, and wish you continued success in your, in your future career.

Thank you Jonathan. Thank you.

Thank you.

[End of Interview]