Dr Louise Bennett

Interviewed by

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Welcome to the Archives of Information Technology. It's the 23rd of July 2018 and we're in London at the British Computer Society. I am Elisabetta Mori, an interviewer with Archives of IT. Today I'll be talking to IT security expert, Dr Louise Bennett. Over the last 30 years she has been an IT and research and development director for companies as Thorn EMI, Logica, AEA Technology and Vivas. Prior to that she worked as a scientist in Overseas Development and the Ministry of Defence for twenty years. Louise chaired the BCS Security Community of Expertise and Identity Assurance Working Group for fourteen years. Now she's on the advisory board of both the Digital Policy Alliance and the Information Assurance Advisory Council. Over the years she has also worked on the government advisory bodies, including the Defence Scientific Advisory Council, Policy IT Organisation and as an expert for the European Commission. She's currently co-chair of the Privacy and Consumer Advisory Group in the Cabinet Office. Her consulting focuses on strategic and corporate governance, the exploitation of new technology and risk management. Her latest work includes identity assurance and payments on the internet, developing resilient organisations from environmental, security and privacy perspectives, including information assurance and fraud prevention.

Welcome Louise.

Thank you.

Let's start with where and when you were born.

I was born in January 1947, which was a very cold winter, in London.

And please can you describe your parents – what were their occupations?

My father was an architect and my mother was a journalist.

And what about your grandparents?

They were architects as well.

Who were the important influences on you in your early life?

Well, obviously my family was a very important influence, and so in fact was my school, which was a very progressive London school. And I think they definitely made me what I am.

What was the name of your school?

It was called North Bridge House.

Where was that?

That was in St John's Wood.

Did your family background influence in any way your choices in subjects at school, at university?

I don't think so at all, because I was always brought up and taught at school that I should do whatever I liked and if I was enthusiastic about it, then I was supported. So, I very much went my own way.

Can you tell us which schools, colleges and universities did you attend? You can trace your education through the early schoolings, secondary schooling, college and higher education, like names, years, early memories?

Well, I probably [laughs]… Well, my first school was a very progressive school, it was co-ed, and the nice thing about it was that although in that era in the 1950s, you know, boys did boys' things and girls did girls' things, and I didn't want to do sewing and knitting and things, I wanted to do carpentry. So I said to the headmaster, can I do carpentry rather than sewing, and he said, of course you can. And so I really enjoyed that and we still have various things that I made in my carpentry class aged seven and eight, including the toolbox with all my tools in it, which my husband even puts his tools in, so that's very impressive. So, we were also, the school was very

unpressurised, you did what you thought was, you know, you were interested in, and in fact, again, very unusually for the 1950s, I actually couldn't read when I was seven or eight and they said I was dyslexic, which is not usually said in that era. Because I suddenly wondered, why was I with all the stupid kids when all the clever kids were in class, trying to read, you know, I was trying to read a book. And so in fact, I was so- and I was told it was because I couldn't read that I'd got to do all this, and I remember vividly the first thing I ever managed to read took me all day to read, the first page of a book by someone called Alison Uttley, which was a book about a little hedgehog, and it took me all day to read it, but after that, and I, you know, I suddenly got the hang of it and I could read and I went from that to being an absolute bookworm in about a year's time. And I was taken out of the remedial classes and went back into the main classes, so I was very, very pleased, I was very happy about that.

[0:05:51]
So, which it is you most enjoy and which were your most successful subjects?

When I was young I enjoyed maths and I enjoyed English, and I enjoyed geography enormously. And my friend and I, I was terribly impressed by people like David Attenborough, in fact. And so my friend and I decided we were going to have a zoo when we grew up and so in all our breaks, if we weren't allowed to go out into the bombsite, which is where we used to play, we would work out where all the countries in the world we were going to collect all these animals from for this fantastic zoo we were going to have. And the biggest, the country we couldn't find anywhere was Komodo, because we wanted to get Komodo dragons because David Attenborough had shown us Komodo dragons on the television. And so I eventually, a couple of years ago, did go to Komodo and saw a Komodo dragon, so I was very, very pleased. But that was my consuming passion and it went on being a consuming passion throughout my school days and I had a fantastic geography teacher at the girls' school I went to later, who really inspired me to go on doing that, so I always wanted to know about all of the world and the animals and so on in it. So, that was fun.

[0:07:35]
And what led you to win the school science cup?

[laughs] School science cup was given, and it was called the Priestley Cup, which is a very funny name, but it was after someone whose surname was Priestley, and it was given to the girl who got the top marks in what was then O level at school in the science subjects. So I was very thrilled to win that cup.

And did you get any special scholarships?

Before I went to university at that time you had A level and S level, S level was scholarship level, and if you passed S level, which I did, then you got some, you were given some money when you went to university to help cover your expenses. But we didn't have to pay for university then, thank goodness.

And where did you go to university?

I went to, first I went to Oxford, to St Anne's College, which was a women's college – there were women's and men's colleges then - and, to read geography. But my tutor was in St John's College and my tutorial partners were boys from St John's, and – young men, I suppose they were – and Oriel College, who are still friends now.

[0:09:04]
So, do you think that studying in a girls' only environment helped your education and career somehow?

I think it probably did, because being at a fairly academic girls' school, it was always assumed - all your teachers were women - and it was always assumed that you could achieve at anything. There was no feeling that the boys should do maths and science and the girls should do languages and things. So I think that made a big difference. I was surrounded by what would be called blue stocking women who assumed that you would go on to do great things. And so I think that made a difference. My mother also had a career and that made an enormous difference, it never occurred to her or to me that I wouldn't go into a career. And she was in fact a journalist on *Picture Post* in the Second World War, and then she was the first woman on television after the war, she was called Jeanne Heal and she was an interviewer, so she interviewed loads

of famous people and they would come round to the house and I would meet them, which was fantastic.

Do you remember anyone in particular?

I remember a lot of the people. I mean one of the most fantastic to meet was Maria Callas, she used to interview particularly women, she was very much into women being successful at things and doing things, and Shirley Summerskill, Baroness Summerskill, who was an early Labour MP, was a great friend of hers and she mentored me quite a bit and she actually gave the toast at my wedding. Again, it was very unusual then for a woman to toast the bride and groom, but that was, you know, she did.

This is very nice. So let's go back to your university years.

Yes.

[0:11:27]
Like how closely were your studies related to your work later on?

Well actually, very closely related, because I studied geography and the two areas that I was most interested in were meteorology and oceanography and I wasn't sure which I wanted to work in. And I had an opportunity to go to America to work at Woods Hole in oceanography, which I didn't take. I, instead, I wanted to use my meteorology and like most young people I was very starry-eyed, so I wanted to help the world, save the world. And my other great passion, as I've already said, was animals and zoology and so I looked at all the scientific research institutes in the UK, I'd worked at the Institute of Oceanography in the UK in one of my summer vacations, but didn't terribly like it and certainly Woods Hole would have been much nicer. But I saw that there was somewhere called the Anti-Locust Research Centre, so I looked up what they did and they forecast locust plagues in Africa and the Middle East and Asia with the Food and Agriculture Organization, using meteorological forecasting, which is very important to, in locust plague dynamics. So, I thought, that's where I'd really like to work, so I got in touch with them and got a job there.

[0:13:04]
Which year was that one?

That was 1968.

And were you using a computer?

Yes.

What was the first time you used a computer in your life?

The first time I used a computer in my life was the Atlas computer at London University and I, you used to have to be very, very careful about how you worked computer programs then, you used to do it on paper tape or punch cards or whatever. And so I did it on paper tape and it was to do a big modelling exercise of weather modelling in North Africa in the Sahara and it took me weeks to punch, you know, to punch it out and then you waited a week to get the information back, which is probably something you could do on hand-held calculator now, but you couldn't then. So that was my introduction to computing. So as far as I was concerned, computing was and always has for me been a means to an end. It's not fascination of the subject itself, it's fascination of what you can achieve if you use it. And I also, when I was there, I was the first person in the UK to use the NOAA satellite data from America, which is their weather satellite and oceanographic and atmospheric satellite data. And we used that in the infrared to see where it had rained in the Sahara. So you could see from the change in the vegetation where it had rained. So you could tie that in with the weather maps that you produced, and of course then in the same way that in computing you did it all by hand, I used to spend the first half of every day drawing the weather maps from all the weather stations in the… all the ships, all the weather stations across Africa and Asia to draw the weather maps. And that actually means that you are really thinking every time you draw what is happening in some place, you know which station's got the wrong temperature gauge and you know everything else, so you really think right down at a deep level, is this right, is this correct, what is going to happen, how is the weather going to change. And I think people of my

generation who've done that in computing, you've done it all by hand, you don't make mistakes. You work very, very hard and because you're doing it by hand and because you're spending hours doing all this, you're really thinking about it and it gives you the time to think about the model you're building, what you're doing, what you're saying in a way that I've been shocked by some younger people working for me more recently, that because they're used to doing everything by computer they don't actually work out in their own mind, you know, an order of magnitude out, you know, that cannot be right. And the same with people who rely on models but don't understand what goes into them. I think that's very dangerous and I feel coming forward that that's very dangerous in the way people using algorithms and artificial intelligence now, studying databases, because if you don't understand the algorithms, you don't understand what you're doing, you have to know what those are. So yeah, it's a very different way of thinking if you've done it right from the beginning.

[0:16:43]
So you were writing your programs…

Yes.

… then you were punching yourself?

Yes.

And were you working in some teams or every moment of your development was on your own?

Well, some things in teams and some things not. Yes, we had a team of us who did the forecasting. There were about, probably about half a dozen of us who would draw all the maps every day. And we not only plotted the maps, we plotted how many locusts different agricultural offices in different countries had seen doing traverses from surveys in different areas. So we would put those together and then we would come together and talk about what did this mean about how many locusts there were in some place, how likely they were to have a successful next generation, which would be a hundredfold plus increase in the numbers of locusts, where they would

move, what would happen, and we would then direct people to go out in Land Rovers to do various things, or take aircraft to spray, or whatever.

Were you working in London or were you working abroad?

I was based in London, but I used to go quite regularly to the Food and Agriculture Organization in Rome and also worked in most of the countries in North and East Africa, more in Morocco than anywhere else, and Algeria, Egypt, Ethiopia, Somalia, Kenya, Mauritania, Senegal, Yemen, you know, all sorts of places.

[0:18:27]
How was the travel in those areas as a woman in the seventies?

In fact people were terribly protective of me, practically everywhere I went. Not everywhere, some places were really, some places were really scary. But on the whole, people were absolutely delightful. They would be terribly worried about something, you know, going wrong when I was in their country. So I usually had a minder who looked after me and took me round the place. But yeah, I saw some scary things. I was working in Ethiopia when the Ethiopian-Eritrean War was going on and I remember my driver taking me, you know, going down to Massawa, we went through a village and there were dead people. I said, you know, we've got to stop and help. And he said, no, we're in a government Land Rover, if we stop and help we'll be killed. So he just put his foot down, off he went. Other places, if I wasn't looked after, you know, people would physically sort of abuse you walking down the street to try and go and have something to eat if you were by yourself. But, as I say, in most countries people were fantastic to me. And one, I did stuff on red locust in Tanzania and I was taken round in a light aircraft from one place to the other, so everywhere I arrived they called me Mama Bird. [laughs] And I'd find the agriculture officers had been waiting, sometimes for days, for me to come and tell them what was happening, how they should recognise the locusts, what they should report, and I drew all the posters and everything that went up, to do that, to report, because it was the first time they'd had a plague of red locusts for a long time. So, I had a fantastic time. It was absolutely brilliant.

How many years did you work for the Anti-Locust Research Centre?

Seven years. And during that time I did a doctorate at Imperial College as an external student in zoology and applied entomology on the work I'd been doing on locust plague dynamics.

That's quite interesting.

It was, it was very interesting, yes, it was great fun.

[0:20:45]
And what changed at some point, why did you leave?

The reason, everyone said, you know, you wanted to save the world and there you are working in overseas aid, why have you now gone to the Ministry of Defence? This is, you know, ridiculous. And there were three main, four, probably four main reasons. I was married then so I didn't want to spend time in Africa.

Which year did you marry in?

Sorry?

In which year did you marry?

I married in 1975. Yeah. 1973, actually. Yes, 1973.

So you got married in 1973 when you were still travelling?

And I left. Yes, and I left Anti-Locust in 1975. After seven years working in overseas aid, I had actually, like a lot of people in overseas aid, I felt it was so corrupt and I felt there was- we knew, scientifically we knew the answer to the problem, but the problems were all political and logistic and, you know, they weren't the problems I could solve, they were the problems that you needed a decent government in the country and honest people to deal with. So I was very disillusioned by overseas aid

by then, I felt the scientific problems had been solved and I also didn't want to be travelling a lot. And it was much less interesting if you didn't travel. And what I really enjoyed was big system modelling, which is what I had been doing and how I'd been using computers and so on. And in fact, I saw an advert from the Ministry of Defence and it said, mathematicians, physicists, etc, but any science discipline would be accepted as an operations analyst. And operations analysis is actually what biologists and zoologists had done in the Second World War, because they had very clear things they could do with chemists and physicists and mathematicians and things. But the other scientific discipline was zoology and biology and so they, most of the people who did operations analysis came from that, and because one did a lot of statistical analysis, a lot of system modelling, that was, it was a very obvious thing to do, so it was actually the kind of computing that I did that made me go to the Ministry of Defence as an operations analyst for the RAF. So that was great fun.

[0:23:37]
Which kind of computers did you use at the time?

By then, moved on from the Atlas computer and the Ministry of Defence was way at the forefront of everything, so they had an ICL computer, but again, it was batch processing and the operating system was called George. And so you, again, you wrote everything out by hand and you actually had people there to punch the cards for you, so this was a big step up in the world. So, I didn't have to punch the cards myself. But, so I used ICL computers and then I started programming using BASIC and Fortran, mainly Fortran, initially when I did the initial operations analysis work that I did, which was to do with, it was to do with recruitment selection and training for the RAF. So it was 'how to' models of, I did a model called the Flying Training Program, which said how many people needed to be recruited in every different kind of place and go through every flying school to keep the flying schools full but not overfull and enable you to man new aircraft that were coming in, like the Tornado.

And was this Fly Trap?

Fly Trap, yes, it was called Fly Trap. Flying Training Program. How did you guess that? [laughs]

[0:25:12]
And this was one of your first roles for the Ministry of Defence?

Yes, that's where I started, yeah.

And what other roles did you cover in the years?

After I'd been doing that for probably four or five years, my boss, who was a chief scientist in the Royal Air Force, said to me, in the future, operations analysts aren't going to get to the top of science in the things, you need to do some hard science. And I said, urgh, you know, I'm not a hard scientist. And he recommended that I went to the Royal Aircraft Establishment at Farnborough. So I moved down there and I started doing programming for simulators for air-to-air air combat simulators, air-to-ground air combat simulators and so on, so I wrote the software for simulators. That was my first job down there, which was great fun, and did lots of trials of different system, new systems for cockpits. So it was bringing in what was called the glass cockpit and doing things like voice interactive systems, the very first voice interactive systems for aircraft. And…

Which year was this?

This was about 1980, I would think, by then. Something like that. So we did the early voice interactive systems and I was technical authority on what is now Typhoon, which was then the Euro Fighter. And so it was how to ensure that and I worked with McDonnell Douglas on the Harrier GR5 AV-8B and the Tornado midlife update. So, I was bringing in new systems. Things like moving map displays to show you where you were, head-up displays, helmet-mounted displays. So it was great fun.

Something we would call wearable technology today?

Yes, that's right. Yes. [laughs]

[0:27:34]
What is your proudest achievement while working for the Ministry of Defence?

I think probably the thing that I was proudest of was there'd been a series of low level accidents in Jaguar aircraft in Germany in bad visibility when they were flying very low, 100, 200 feet above the ground, and then for reasons that no one could understand, they would crash. They eventually discovered it was because the altimeter was faulty, but they displayed something to say that the altimeter was faulty and if you know what a flight thing looks like on an aircraft, it's a circle with a line through it when everything's working well, like that, and a bit like a sort of underground sign, and you fly straight and level according to the thing and it shows you if you're moving. So if that line moves slightly then you know you're not flying straight and level and if you, and if it fails, then you ought to go up. But the sign that they had for it failing was a cross, and so, because it was a cross we realised in the simulator when we were simulating this, and we were telling people we were going to have an altitude failure and they were meant to pull up, but of course someone who's been looking at a line and trying to keep it straight and level, when it's a cross they move it and they just fly into the ground. And so we tried all sorts of other things and we realised that if we wrote 'Alt fail' across the thing, it was so different that it worked and when we, as soon as we did that for when the altimeter had failed, the – and that was retro-fitted into all the Jaguars – all the crashes stopped. So I was very proud of that.

[0:29:37]
Congratulations. And how did you change your job position?

Well, I got various promotions and I became what was called a superintendent, which is quite senior in the thing, of flight systems. So I was dealing with all of the test aircraft and things that we had for cockpits, and at that time we were doing helmet-mounted displays. And those were taken down to the Falkland Islands in the Falklands War as experimental equipment, which was great and made a hell of a difference, because although they weren't certified for flying, the helicopter pilots could use them and they could see to land on islands and things, so that was great. And then I changed jobs and became Superintendent of Air-to-Air Guided Weapons

and did, was responsible for the advanced short range, advanced medium range air-to-air guided missile programme, which was very, very interesting.

[0:30:53]
So from the Ministry of Defence, did you move to other companies? Which?

Well no, well one of the things that I'd complained about vigorously when I was, specially when I became a superintendent, was that the scientific civil servants weren't treated as well as the administrative civil servants and they ought to have proper career progression and things. So for my sins they said, would you want to become responsible for the career progression of scientists by coming to London to work in civilian management. So I thought, well god, yeah, okay, I will. And I absolutely loathed it. And so the people I'd been working with in industry when I was at Farnborough said why are you doing this? And I said to them, I don't know why I'm doing this, this is absolutely unspeakable. It was like living in *Yes, Minister*. My boss was exactly like someone in *Yes, Minister* and I thought, I can't stand this. I'd never worked for anyone other than a scientist before in my life, thought no, this is absolutely not for me. And so I was offered jobs by a number of companies outside and I accepted a job with Thorn EMI.

[0:32:17]
What were your roles in Thorn EMI?

Well, when I moved there, because I'd been very much involved in the research programme, one of the other companies objected to my going there, because they said I knew their trade secrets. So I wasn't allowed to work in missile research there and so they asked me to be their IT Director, and I thought, why not. So I became IT Director of Thorn EMI Electronics and that meant that I got into much more administrative kind of IT and what I did was to integrate, introduce computer integrated manufacturing into all of the factories in the UK and the USA, which was very, very interesting and something completely different. And it made me realise how much you have to take account of people, because, you know, the people on the factory floor, I realised, were really scared that computer integrated manufacturing would mean they might lose their jobs, they might have to do things differently. So

actually, I started to realise that it was an enormous change programme for people. And the directors of each other factory didn't want me to do it, and I couldn't understand why, and then I discovered they realised that if I introduced a common computer integrated manufacturing system across all the factories, then we could move work from one factory to another, whereas when they all had separate systems, separate parts, numbering systems and all the rest of it, it was impossible. And in fact the biggest challenge was the parts numbering system because, you know, things like that are really difficult. And I suppose one of the things that really taught me, as well as the importance of taking all the people with you if you're trying to change things is that again, you've got to get down to the detail, and you know, the devil's always in the detail in any big IT programme. And so you've got to learn to deal with that.

[0:34:27]
Have you got any particular memory of those times?

[sighs] Well, I think the most interesting thing was because I became R&D director as well as IT director and again, research has always been my, you know, great thing, and I moved between companies from the defence company to Thorn Security and we did – this was way back in the 1980s, late 1980s – we did the early work on biometrics. So we were, we had in our research centre an ordinary house and we made it a smart house. You know, people think it's very new, but it wasn't. So we had a keypad to let you in, we had everything linked together and so on, and because we did access control and environmental control systems as well, and fire systems, we linked all these together so that the heating would come on when you came in and the blinds would go up and down and the curtains would close and all the rest of it. And whenever we had guests, we put them up in this thing, we told them how to use it, and we would say do you mind if we see how you use all of our clever smart home. And so we had really interesting work. And we also did work in biometrics, so we did work comparing biometrics for different access control systems. So fingerprints, handprints, iris prints, voice recognition systems, signature recognition systems, writing recognition systems, you name it, we worked on all of those. And, as I say, but that was 30 years ago and yet people think this is all new, but it wasn't. And so we worked out what were the best control systems and how could people use them and what were the most effective, depending on whether you cared about false

positives or false negatives, because that makes a difference to what you choose to, you know, what you choose to do. And because I was working in very high security systems we never wanted false positives, but of course, if you're working in consumer systems like a lot of the biometrics used in consumer systems now, they don't want false negatives because it will annoy – piss off, I think, is the word I was going to say [laughs] – the customer, the consumer, whereas we were much more concerned about can anyone who isn't the person we want actually get into that building or into that system, you know, how can we protect it, how can we do really, really good security. And so we did some very exciting things, like we did all the security and fire systems for Euro Tunnel when it, you know, and that was absolutely fascinating. I did that with a joint venture with us, and in France. Used to annoy the people – I'm terrible at languages – and I'd learnt my French in French West Africa, which the French don't consider very beautiful. And so they used to insist on having everything in French and then they would hear my awful French with no, you know, no 'le' and 'la' and all done in the imperfect. [laughs] And so they'd say, Louise, it's fine. We'll do it all in English. So, they could always speak English more beautifully than I could speak French.

[0:38:38]
Do you remember any other like kind of funny episode like with biometrics experiments?

[laughs] I remember one of the things was because I was the director of this high integrity security company, we were doing quite a lot of work with Middle Eastern countries and so, I was always called Dr Bennett, and so it was never clear that I was a woman, and they knew that it wouldn't be well accepted in the Middle East in that time, a woman doing the things. So I would always be out of the country when they were there, so I could never take anyone to the nightclubs or anything like that. And no one ever said that I wasn't a man, which was the assumption. So I remember a time when I picked up the phone because my secretary wasn't there and so the person assumed, naturally, that I – said, 'Is Dr Bennett there?' And I said, 'Yes'. And they said, 'Can I speak to him?' And I thought, oh, this is going to be a bit difficult. So I said, 'He's very busy at the moment'. He said, 'Oh well, he's expecting me to call'. I said, 'Oh, is he? Right.' [laughs] 'I will tell him you called.' [laughs] Because I

didn't want to admit that I was a woman and knew perfectly well they hadn't made any arrangement, because they didn't know that I was a woman. [laughs]

This reminds me of Dame Stephanie Shirley.

Oh right. Yes, Steve Shirley, yes. Well, that was when I first met her, when I was working with Thorn EMI, because the son of a great friend of hers from F International – FI Group as it was then – worked for me. And so I started working with her into women into information technology, and she was a fabulous woman, absolutely brilliant, yeah. Yeah.

[0:40:46]
When was your first meeting? Which year?

Oh gosh. It was in the 1980s. I honestly can't remember when.

Where was that?

Well, the first time I… the first time I used FI Group was actually when I was at the Royal Aircraft Establishment, when I wanted some contracting done and I'd heard – and it went out to tender – and one of the companies I went out to tender was FI, and I was so intrigued that they were, had women working from home doing it and they were very competitive and so I was one of the first people to use her in the early 1980s. So it was, it was from then. I can't remember when I first met her, some time like that. And then she got me involved into the, in the Worshipful Company of Information Technologists, took me there to a couple of lunches and I became a, you know, I joined, became a liveryman. Of course she was very keen that there should be just as many women as men in the livery company, yeah.

[0:42:02]
So, you also developed the IT security for most banks in the UK.

Yes.

And then, what happened? When did you leave Thorn EMI?

[0:42:20]
I left Thorn EMI probably about… in the late eighties. I'd been doing some work for Colin Southgate who was the head of Thorn EMI group and he was selling all the technology companies. And so the lighting, security and electronics companies, which we called the LSE project [laughs], we realised that there was no one who would take over all of those, it was a conglomerate, all those companies together. So it was who each company was going to be sold to. And my company was sold eventually to an American company called Tyco and I didn't want to work for them, and so I accepted redundancy when it was sold and went quite soon to Logica. I went to Logica because Martin Read had been the- in Marconi, and Marconi had been one of the companies that might have bought my part of Thorn EMI, and so he had done due diligence on my unit and when it was sold to someone else and he went to be chief executive of Logica, I got in touch with him and said, you know, you do know me because you did due diligence on me in Thorn EMI, is there any chance of a job with you because my company's been sold to, whoever it was, and I don't want to go with them, so I've been made redundant. So I was interviewed there and got a job at Logica, working in the defence and security side.

So what were your roles in Logica?

My first role was to do, build a consulting group for the defence organisation, which was down in Cobham, and I was responsible for things like security and the CLEF, who does work for the government on that. And I did that for a couple of years and then moved to Logica in London as Director of the Government Group, which was covering all government work other than defence. So worked, did a, won a partnership with HMRC and worked for all sorts of different government departments, and then set up a consulting group and was director for the R&D in Cambridge, including things like Vocalis, which is one of the early commercial voice recognition systems, having done it originally in RAE and then for security access control and so on. So it sort of, it all links together in a sensible fashion.

[0:45:36]
Have you got any memory of those years, like did you have any children in the meantime?

Oh yes.

What was your family?

Yes, I had two children, in fact when I was at the Ministry of Defence. My second child was born in fact when I was, first went to the Royal Aircraft Establishment and I'd told the people in the operations research side, I said I'm expecting a baby, do you think they'll be happy to have me, expecting a baby down at, out at RAE? And they said, oh yes, it'll be absolutely fine. And I didn't realise that they'd never told the Royal Aircraft Establishment that I was expecting a baby, didn't come up when I went there for my interview, so when I became Superintendent of Cockpit Systems I went through the files and found the file on myself. And I saw a letter, my predecessor, and said, why the bloody hell have you sent me a woman who's expecting a baby [laughing] to run this simulator. So I thought, mm, yes, that's er, yeah, nice sort of, nice sexist remark at er… But actually, it all worked out fine, so, so yes, I had two, had a couple of children. So by the time I was in Logica they were getting on for twenty, or something like that.

[0:47:09]
And what happened after your experience in Logica?

I went to, when AEA Technology, which was a, AEA Technology was the Atomic Energy Establishment, was privatised, they wanted to set up a new- they wanted to take- they wanted to diversify and they were thinking of setting up a risk management division, taking nuclear risk management into the business sector. And I went, I talked to them about it and I thought this was really very interesting, and I helped a couple of other people who were in AEA Technology, as someone from outside, to set up the business and I went there as the marketing and sales director of the new company. So we set up a company called Risk Solutions, which still exists, and was a subsidiary of AEA Technology.

[0:48:25]
So you slightly moved from research and development to marketing and…

Yes. Yeah, marketing and sales, but it was still a lot of modelling and risk management is all about seeing the big picture and working out how you can deal with it. So, yes, much less hand… no, no hands-on computing really then, but again, sort of modelling and working out how to, how to use technology well and how to do risk management.

And what brought you to found Vivas in 2001?

Well, because AEA Technology had said that, told us that we could buy out our subsidiary if we wanted to, and we wanted to, so the three of us who were directors said we wanted to buy it out and made them an offer, which they didn't accept because we were making money. So we were all a bit annoyed about that, so we- so I left the company and set up, set up my own company and by that time one of the things that we'd done in AEA Technology was to have a, make it a homeworking company just like F International had been with Steve Shirley and which was becoming a more common thing to do then. So it was a project-based homeworking company, but one of the things I found didn't work about a project-based homeworking company was if you expanded as we had in Risk Solutions and you had people straight from university, they actually need hand-holding and you can't work from home. I don't think you can. I think you can if you're all very experienced people and senior consultants and you can talk and you know how to do the job. Well, once you've got graduates or apprentices, people you've got to train, then you can't really do it as a networked company. So by the time I set up Vivas I really, the children had left home and things and I wanted to have more, I wanted to have total control of my life, so [laughs], so that was why.

[0:50:58]
And what was your experience in the Police IT Organisation?

In the what?

Police IT Organisation.

Oh right, okay. I was, the Police IT Organisation tried to do common IT across the whole things and ran things like the Police National Computer and so on. I didn't- I was there as a non-executive director, I was deputy chairman of the Police IT Organisation and the chairman had been someone I'd worked with in the Ministry of Defence and quite a lot of the people there were connected with that. So I was a non-executive and I was looking at how they developed all their systems and, you know, questioning the executive about how they had got there, so it's a different kind of role. It was the kind of thing that I very much wanted to do, because after I set up Vivas I decided I wanted to do a portfolio of jobs, so I only worked in Vivas three days a week and the other two days I did things that really interested me.

[0:52:16]
Have you got any special memory of those years with…?

Of… of, of Risk Solutions and Vivas and things?

Yeah.

I think probably the best memories, I think we had a fantastic administrator in Risk Solutions, called Trisha [ph], and she had an ability to find the most wonderful places to give parties. So we used to give, we used to give great parties to our customers. So am I allowed to, other than working it's all the, it's the kind of parties that we did. And we, you know, places like The Magic Circle where you had – which is a wonderful little theatre near Euston – where they did magic shows and things, and you know, all sorts of great venues. And used The Magic Circle to give a party for my daughter after her wedding, so [laughs], so that was great. But I, workwise, I think the most interesting things there were probably the enormous variety of people that we met. We did a lot of work for people like the National Audio Office on value for money studies and developed things like risk management communications exercises for the government. So the first one we did was based on foot and mouth disease. So, again, that took me back to my comfort zone: animals and diseases and plague

dynamics and things like that. And we taught people how to do the television and radio interviews when something had gone wrong with their, with, you know, in their organisation. And so it's very similar to the kind of things you teach, it's sort of the beginning of thinking about resilience, because the great thing in IT security now is that I think almost anyone in the security industry will tell you, you're going to have a breach. It's not a question of if, it's a question of when, and the most important thing is to know very quickly that you've had it and to communicate well with everybody about what has happened, what you're doing and to reassure people that you've got it under control. Well, you need to get it under control first to reassure people. So it was developing all sorts of things like that, how do you mitigate the risks, how do you stop the risk destroying your business. I think that's incredibly important and I think that's incredibly important now in looking at security, how do you, how do you monitor what's going on, how do you make sure that you're going to deal with bad things when they happen, because with the best will in the world and however brilliant you've been, things change so fast you've got to be able to deal with it. And you've got to be able to communicate well about how you've managed the situation.

[0:56:03]
This is very interesting. So, what do you think was your proudest achievement during your whole career?

Oh, gosh.

[both laughing]

Proudest achievement? Ah, who knows? Probably, going way, way back, the thing I'm probably most proud of is the fact that my, the work I did for my doctorate resulted in writing, getting an article accepted by *Nature*. So I think actually, you know, the proudest thing in my research is to have, have written a paper in *Nature*.

Because I think that even if you were like successful manager and entrepreneur, deep inside probably you're still a scientist.

Yes, I think I am, yeah.

And so this is all about being a researcher.

Yes, yeah.

[0:57:16]
So, you helped developing the IT security for most banks in the UK, but you also had important operational consulting roles in the public sector. So, what in your opinion is the difference between working for security in the private sector compared to the public one? What are the different like… issues?

Well, I think the – there are lots of differences. I mean the two things that you've picked out are, there's a big difference between physical security and IT security. I say there's a big difference, but there's also a lot of overlap. So, quite a lot of the work I did in the private sector has been both physical security and cyber security, in a sense. But the, the thing that's most different in the public and the private sector, it was most different when I moved from the public sector to the private sector, was moving from something that was really research and you were given so much money and you tried to solve the problem and you could go on for a long time, there was much less time pressure. Soon as I was doing research in the private sector, you had to have the business case and you were much more rigorous, and I think it's really important to be rigorous in this way about saying between here and, you know, the idea I have is going to solve this problem over here and we're here at the moment. The route between my idea and getting there, what are the things that are going to stop me doing it, so what are the risks. So, I think right from the start, in the private sector I always did risk-based project management, in the public sector I didn't. So, in the private sector you're saying it would be an absolutely brilliant idea if I could do *x*, however, how much money can I afford to spend to do *x*, and at what point am I going to stop. So you'd often have a great idea and you'd think, if I could do this - I'll take an example that's not IT – when I was in Thorn Security we made fire systems as well as access control systems and so on, and we knew that if we- two things that we tried to do several times, first one was if our detectors were cheaper than other people's detectors for fire and smoke and more reliable, that would save us a hell of a lot of money in any installation that we did. And we knew that if we could have a smoke

detector that was just a piece of paper or a surface with something on it that would change colour, say, or when it, like doing a litmus test, you know how people do litmus tests, for an acid or something. And we knew that if we could do that first in the market it would be great, but we knew where the limitations were, that you needed things that are around now, you needed nanotechnology to be able to do it. And until you'd got that, until you'd got the materials that could do these things, it wasn't going to happen. So we would look at it very quickly again, knowing that was the thing that was preventing us from doing it. The other thing we wanted to do was particularly in historic buildings and palaces – we did the security for the royal palaces – we wanted to be able to install detectors that were wireless. So we actually bought a company in America that had the wireless technology, because we knew again, if we didn't have to wire these places up, but anywhere we didn't have to wire them up, but particularly in a historic area, you could, you know, you could do that and no one else could do it, so how could we patent this. So we introduced those kind of, what that wireless technology in the eighties, which is now commonplace, but it was pretty expensive then but it meant we could put something in somewhere like Hampton Court Palace without destroying all the fabric of the building and we could detect a fire. So, so you're very much focussed on the end product and I think that's what's always excited me about everything I've done, I've wanted to get to the end product. I've not wanted to do it for itself, it's because I've wanted to achieve something like you want to stop a plague of locusts eating all the crops, you know, you want to stop a fire consuming a building, you want to, you know, do things like this. So I think, I'm horrified when I go back, as I still do, and look at research in defence and I see that some people who are really keen on some area are still working on the same areas that they were 30 years ago when I was there and they're no further forward but they know perfectly well what is stopping them and that all of those research programmes, you should stop them. Not because you don't want to achieve the thing, but because you should just go back to them from time to time and say, has, has the risk that I can't achieve this, has that actually disappeared because of new materials, because of new ways of doing things, because you suddenly have wireless, because you have RFID tags, because you have wearable technology, you know. What are the things that are stopping you achieving that breakthrough? But you shouldn't be having a large team working on it for ever and ever just because it's fascinating, however much you want to do that, you need to use your resources much better. So I think that the

private sector uses its resources much better if they're going to be successful, and I think that's, that's to me the biggest difference.

[1:04:28]
So, we have seen, like security is like, it's a very general term, so it involves IT in a very, very broad way. So we can think about World War Two, like we needed technologies for secure messaging on one hand and codebreaking on the other hand.

Yeah.

And, like you work in defence systems and it's a, this is another issue, so according to you, what are the critical issues in security today in the public sector? And what in…

In the public sector?

Yeah. Like if you think about… like the difference like between like being a company and being the state. So you have like to face two different kinds of security. Or maybe you don't see any difference.

I don't think I, I don't think I see any difference in the problems. I think that, I think that big data collection is, is very problematic. I think it's incredibly, the ethics of big data analytics are very, very important to understand. I think the general data protection regulation that's just come in has done a tremendous amount of good in that it's made people in both the public and the private sector think about the data they collect, think about how they use it, think about how long they ought to keep it. I mean they should have been thinking about it before, but everyone likes to hoard data. They think it might be useful at some time in the future and I think it's made people clear out the Augean stables [laughs], you know, say actually, the biggest problem in a lot of the public sector is the same problem that the banks have, that they've got an awful lot of legacy systems that have been created. I see people still using systems that I was involved in writing 30, 40 years ago, you know. These legacy systems are incredibly sensitive, incredibly difficult, you just have to look at all the banks that have had problems when they've done a merger and tried to bring two lots of systems together. Because they're operating 24/7/365, they, they daren't take them down.

They often decide, oh, I'm going to just go to a completely new system. You have to be patient, you have to- I'm a great believer that you say, if you're going to move to a new system, you don't do it big bang, you do it with a pilot, but I think people use Agile badly at the moment, they use it as an excuse for not doing things properly. I think you've got to make, you've got to do some trials, do some pilots, decide I need this new system to operate in this way over here and it will be modern, it will be federated, it will, you know, it'll be web-based and I will design in the appropriate security for it, which is completely different from the security you may have had before. And you've got to put new people, new customers, new claimants for benefits or whatever, on to the new system as it comes in and you've got to do parallel running, you know. And you do it to a point where you are absolutely confident your new system is working, it's working for these new people who've gone on it, you know, it can scale up, it all works fine, it's got all the security you want, it's, you know, it's really well-founded. And then you decide at some point, and there's no magic answer to when that point is, yes, I'm now going to move the people who are left on there on to it and I'm going to clean the data, because people are using, they're doing data analytics on datasets that are wrong, that are old, that are out of date, that someone has mis-keyed something, people have moved house, people, you know, people have died, etc, and you're doing, you're doing data analytics on really bad things. [1:09:47] I think the other big thing that worries me, going back to what I said about if you're of my generation and you've done everything yourself by hand to start with, people don't understand the algorithms they're using. I'm horrified by people who are running models that they don't understand. This is insanity. No director should, you know, if you don't understand the algorithms, you know, you shouldn't be doing fast trading or something if you don't understand what is actually- you've got to know what's happening inside the black box, you can't just rely on a black box. And particularly so in anything that requires any security, you've got to understand it and I think it's incredibly important for people really to understand the algorithms and I think that people shouldn't use things like Agile to, you know, move fast and break things. Fine, that's for the experimental phase, but as soon as you're going to build a system that you're really going to use, because I've done a lot of real-time computing and safety critical systems on aircraft, you know, you want to make bloody certain they work, you know, they've got to work properly. And I think you should regard security in very much the same way as safety critical systems. You've

got to understand it, you've got to make sure it works in every circumstance, you've got to know how the algorithms work, you've got to understand it through and through, and that's exactly the same if you're in the public or the private sector. Don't think it's any different.

So I totally agree with you, specially like on the ethics, big datas.

Yeah. I think it's absolutely right that you've got to make it clear to people, you know, I'm one of those nerds who actually reads the bloody privacy policy and things, and, you know, it shouldn't be, I shouldn't have to read 27 pages, it should be no more than a screenful of stuff and it should be really simple to understand. It should be absolutely intuitive that you know what you're doing.

[1:12:22]
So, like as a marketing expert, like, so, in the case of an emergency what would be your like, your advice?

In the case of an emer…?

An emergency, like in the, in the, in the case of like, like what you were doing for the Anti-Locust… at some point you told like that you were given advice also like dealing with, like some kind of emergency situation, so what would be like your advice? Like what would be your communication to people about like ethics and big data now? Like what's like this…

About ethics and big data? Well, there's a difference. You said in an emergency situation. In an emergency situation, the key thing is you have got to have rehearsed your emergency situation. My children used to get terribly annoyed with me when I went on holiday because I would say to them, now, this is where our rooms are, have you read the fire evacuation system? Do you know where we've got to go if a fire happens? Because I've come from that background I will always see where is the fire exit, is it blocked, how do I get to it, so that I know if I'm woken up in the middle of the night, how to get out. And I think it's very important that people rehearse any problem, that they really understand what their role is, what they've got to do, what

they've got to do as an individual, what they've got to do as a manager. So I think that's incredibly important.

[1:14:16]
And what are, you think, are the many issues in regards to wearable technologies…

Sorry?

…to wearable technologies instead?

Well, one of my other great concerns about security at the moment is security of the Internet of Things. Because I know perfectly well from someone who produced the things, so to speak, when they were fire systems and so on, that they haven't, you know, when you're selling things commercially what you're selling is the ability to do something with whatever that thing is, not how to make it secure. And so I think everyone doing things like the Internet of Things has got to put security into them. I think it's very important that in any consumer electronics systems, be it things like baby cams at home, your Barbie doll that you give to your kid and anything you wear, they've got to be secure by default, they've got to be secure by design and the user has got to deliberately decide that they don't want them to be secure, not the other way round. I think that's incredibly important from a consumer protection point of view. I think wearables and medical devices, I think there's fantastic opportunities, they're fantastic opportunities for IT in the whole of the health and care sector, but you have got to make sure that all of those systems have security. When you think of an implant in someone's head to control Parkinson's disease, or a pacemaker, or the kind of things that I used to have to monitor my mother who had Alzheimer's and lived at home, to make sure she hadn't gone out the front door and to register when she got up from her chair or got out of her bed, so that the carer would know where she was. These things have really important implications for security and privacy, they're highly sensitive. You know, if someone's got a pump that's pumping in, you know, something for insulin for their diabetes or something, if someone can hack into it and kill them, this is not only isn't acceptable, you've got to have proper security in all of these systems and if you have and if you design them with security by design and privacy by design, and you design them really robustly, then I think you can do

fantastic things with them and I think it is completely unacceptable for people not to do that and, you know, I think it's very worrying when you see how little security there is on the Internet of Things, how little security there is with wearables. I mean it doesn't matter terribly – I could tell you a funny story about that – but it doesn't matter terribly if, you know, someone gets my Fitbit information, because it's just how many steps I've taken, whatever, but, if someone can interfere with or know about some kind of medical device, then it sure as hell does matter.

Absolutely, absolutely.

Yeah.

[1:18:20]
And, another thing is I see – I mean this is some kind of crime, what is like, you work also in security and crime, and especially in financial services, can you tell anything about this? Like about your experience, if you can, of course. [laughs]

Well, again, I mean I think one of the things that's incredibly important and is understood very well in the financial services sector, I did some early work on internet payments and the essential thing there is that literally millisecond by millisecond through that payment stream, that you know who has liability. If something goes wrong, you know, how is, you know, if it's my £500 being, you know, given to you, if something, someone intercepts that transaction and diverts the £500 to somewhere else, who is responsible for that. Now, by and large, financial services companies accept that they have some responsibility for making sure that that doesn't happen, but you have to know exactly right through the chain of transactions at which point has it moved from Bank A to Bank B, to this account, to that account and if someone intercepts it and takes the money away somewhere through that transaction, who has liability. And that is, I think, incredibly important and absolutely essential. And I think that one of the things that, going back to what we were talking about, big data analysis, big data analysis is used to anticipate fraudulent transactions that there might be and I think most of us as general public are quite reassured when we're doing some high value transaction that there's some query from the bank about whether, you know, is it really us spending, you know, £3,000 on that or buying a house or

something. That's very important to do. But, the big problem is doing it the right amount and changing the way that you do your risk analysis, because if your algorithm has said that… if the data that you've used to say these are unusual transactions that you should query, you need to make sure that you've got a representative dataset and that it is reliable in relation to different groups of people, because the data, you may have based all your stuff on a dataset that isn't actually representative of all the groups of people you have. So that if you're continually saying, well actually, women don't spend this amount of money on things, they only spend it on cosmetics and clothes, but if, you know, they won't be spending it on, you know, buying something for their car, just to be, you know, stupid, then every time a woman tries to buy something for the car you say that must be fraudulent. You know, that's not sensible and I think a lot of the data analytics that are done on things like fraud are not necessarily picking out what is truly, because fraud changes so fast, because as soon as something is, you know, as soon as a fraudster realises that you're doing that check to see if this is happening in that kind of online transaction, they will move to something else. Whereas the ordinary punter is still behaving in that way that is considered to be fraudulent, but you're not finding fraud, you're finding something, you're finding something else. And I think the balance between who you say is likely to be a fraud and if you're trying to anticipate, as some of the systems do, will this person behave badly, will this person, is this person doing this because they're going to mug someone coming out of the station, you can have something that says most phones, most theft of phones happens outside railway stations and underground stations, because people get out, they turn on their phone, both to hear something new but also to see where they are and whatever, and so that's where, you know, muggers will go. So if someone's waiting outside a bank station, outside a tube station apparently doing nothing and the police pick up all the people who are apparently doing that, but they're actually waiting for their girlfriend to get off the train, but they're picking them up, you know, thinking that they're about to steal someone's phone. This isn't good policing. So you've got to do the analytics right, you've got to understand what it is and you've got to think what behaviours might people, you know, be hanging around in that area for, is there a perfectly legitimate reason why they should be there.

[1:25:04]
So what do you think are the biggest challenges and issues related to IT and security in the next five years?

Well, I think the Internet of Things will continue, the security of the Internet of Things will just get bigger and bigger. I think that, I think that we're at a point where we've got an enormous danger of people using analytics that they don't truly understand and making a lot of false assumptions that are not correct and therefore doing harm rather than good. I think we've got an enormous challenge to protect people's privacy in a consumer-friendly way. I think it's extremely difficult, I think people are introducing more and more two-factor authentication, which is a good thing, but it can be done in ways that are very intrusive, may not work terribly well, may not work well for certain sub-groups of the population, and we've got to be very aware of that. So I think it's quite difficult.

[1:26:42]
Do you think the population is really aware of the risks of, like related to privacy and related to all these connected devices? Because maybe, like there is also, like education in this sense.

I think people are not as aware as they ought to be.

And so probably also industry doesn't implement enough security because it's not…

I think there's…

It's not requested by the public, because it's not requested by the consumer, like you're not aware of it.

I think it's a, it's a very difficult balance. So many of, you know, the large tech companies' business models are that it's free to you because they have your data. That's, I think people are not as aware as they ought to be that that's the bargain. You know, there's no such thing as a free lunch. So, you know, most, you know, a lot of people are perfectly happy with that bargain, but I think they should be made much

more aware of it and I think education in schools needs to happen right from primary school level to understand what it means. And I think the Estonians have very good education for children in primary school and secondary school to do with what's called critical reasoning, critical reasoning to understand what are authentic sources of information, what- and not authentic sources and information, to understand how to deal with things and to be taught from an early age responsibility to understand that in the same way that most parents and most teachers will teach a child, you shouldn't, you know, immediately hit someone because they've taken the toy you want to play with. People understand how to teach things in the physical world that you don't do that, but they don't understand how to teach people to behave properly online. So, and I think one of the things that worries me most is the extent of bullying and inappropriate behaviour by children online. Some of it is because they've inadvertently got there, but face-to-face, we're not going to be really rude to each other. You know, we're not going to say, you know, mostly you're not going to say nasty things. I remember when email first came along and, you know, I was really annoyed with someone one evening and I thought, argh, and so I wrote- and I sent it and then I thought, oh no! You know, you need to think before you click. And if I'm going to be rude or critical of someone, you know, if they're working for me or whatever, or I'm annoyed with how they've behaved, if I'm going to do it by email, then I will put it in draft and look at it the next day, in the cold light of day. But, you know, children aren't taught how to do that, they say really hurtful things to other kids online and I remember, you know, working with, doing some work with Childnet and talking to some primary school children who were all saying to me, some of my friends are on Facebook, of course I'm not because we're not allowed to be on Facebook till we're thirteen. And these were primary school kids. And they said, you know, but actually, some sort of, this friend of mine looked up Barbie dolls and got some really horrible pictures [laughs] and you think, oh god, you know. There has to be some kind of age checking so that kids can't inadvertently go there, but most kids are more savvy than their parents are about things, so they may go to some nasty sites. But, the important thing is that if they're talking with each other, they need to realise that if they're bullying someone online, that it's 24/7/365, you can't get away with it. If you were being physically bullied at school, when you come home, it's all over and maybe you tell your parents, maybe you don't, but it's not happening all the time. But if it's online, it's happening all the time and that's, that's terrible for kids' self-esteem

and they've got to, you know, they have to be taught how to behave and they have to be taught that, you know, from a young age. If someone, if a kid's been doing that when they're seven, eight, nine, they're not going to suddenly be taught to behave better when they're fifteen or sixteen. You've got to, you've got to bring it into the primary school and do proper education.

[1:32:40]
Are you on Facebook or any other social media?

No.

[both laughing]

How did you guess? [laughs]

So what do you think will change in twenty years?

So, what do I think will change in twenty years?

In twenty years.

Oh, goodness me.

Like, a longer projection.

Oh, that's a hell of a long way away.

Like your modelling. [laughs]

I think, I'm a great optimist, I think in twenty years' time a lot of the things we're worried about now, we'll think why, why on earth did people worry about those things. I think in twenty years' time, oh - I'm being very optimistic here – I think there's enormous potential for IT in the health and social care area, absolutely fantastic potential. And I hope, I hope that people will have embraced it in those

environments. I mean there have been trials that have gone on for 30 years and, and yet it's still not being properly embraced in the health and social care area. I'm hoping that in my dotage that I will have a nice pet robot that I can be nice to but I don't have to worry about feeding it or anything, or if I've got in a temper, if I throw it away somewhere, it'll be okay. I hope that, I hope that I will be able to travel around really well, not in a driverless car, because I don't think that's going to happen in twenty years, but that I will be able to get about, round my home and do things, I'll have lots of aids that can help me to do things that are, you know, that it'll be even better than FaceTime and Skype to talk to my children and grandchildren and, you know, everything else. And I'll have a really full life that I'll be reminded when to take all my pills and, you know, that a whole lot of, that when I physically have trouble getting out of my chair it'll lift me up and stand me on my feet and keep me going. So I think the health and social care scene can be transformed by IT and I just hope that all this stupid 'not invented here' that you see in that area will have been overcome and the ageing population will be really well looked after.

[1:35:43]
And what advice would you give to someone entering the IT industry today?

Oh, I'd say it's the most exciting area you could possibly get into. And I would say the thing you've got to remember is that a good employee is someone who's really enthusiastic and that as long as you achieve some threshold in, you know, you go above some talent threshold, whatever area you want to go into, that the world'll be your oyster and that your employer, if you do indeed have an employer rather than being self-employed, will employ you because you're hard working and because you're enthusiastic. And that right through your career you've got to keep on retraining. I think IT will, it changes so fast, I mean particularly the security area, you've got to embrace continuous professional development. You've got to keep on learning new things, never stop learning new things.

[1:37:14]
And would you like to give a special advice for women?

[laughs] I think the world that I grew up in is probably quite different from the world there is now. I think I was lucky in a sense that because I always worked in areas where there were very few women, you knew you'd be noticed, but what that should make you do is do even better than everyone else, because you know that everyone's, you know, if you're in a male-dominated area, and IT security is male-dominated, there are only 17% of people in IT are women in this country and in that, security, it's only 7%. Yeah. So it's, it's, it'll change, there will be more women in it, but I think if you're a woman you know you've got to do better than the men, which means you've got to work harder. So, work hard, be enthusiastic and never, never whinge. [laughs]

Is there any memory you want to share about this?

What about? [laughs]

[1:38:47]
Your experience, you already shared some, like when you were pregnant. Is there anything like you want to share…?

I think, I think the thing that always really, really annoyed me when I heard people saying it about me, was, it's absolutely infuriating if people say you're only in the job you are because, because they want to help their percentage of women. There's nothing, nothing more infuriating than that. You've just got to show them it's not true. But, it's, it's… it just has to be water off a duck's back, if you get annoyed about it. I wouldn't, I don't think, I don't think you do yourself any good to complain endlessly about being discriminated against, I think you just make yourself unhappy, so I think you just have to shrug it off and be better.

Thank you very much.

[recording ends at 1:40:15]