Oral History of Sir Robin Saxby

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with
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Fairbairn: We're here at the Computer History Museum. And my name is Doug Fairbairn. And we're sitting with Sir Robin Saxby. And we're going to be covering his oral history. Along with me is Dane Elliot. Dane will you introduce yourself?

Elliot: My name is Dane Elliot. I go back with Robin to the '90s, where we were usually on opposite sides, and it's fascinating for me start catching up again.

Saxby: Thank you very much.

Fairbairn: Okay. This is Doug Fairbairn again, and I'm going to open the questioning, and Robin, we're going to go back to, before puberty. Where were you born, what was your early family life like, parents, brothers, sisters? What was the environment that you grew up in?

Saxby: I'm a post-war '60s child. My dad said I would have been born sooner had it not been for the Second World War. So I was born in '47. I'm about as old as the transistor. I'm actually a little bit older than the transistor. And I was actually born two months premature, because there was a snow-drift and my mum was shifting snow, and her waters broke, and I spent the first two months of my life looked after by nurses, by a fire, apparently. So that's my heritage. I was in the middle part of England. It was actually at that time a very industrial town. It was called the center of industrial England. It was making glass, it was making tubes, and it was coal mining.

Fairbairn: What town was that?

Saxby: Chesterfield.

Saxby: My earliest recollection of my interest in technology—I think was when I was about three or four, going shopping with my mum, there were telephone jointers digging up the road and playing with wires. I was really interested in that. So that's my recollection—I think she left me looking at them. And again, I can remember being on a holiday and finding myself in the exchange room. They thought I was lost, but I was in the telephone exchange, looking at stuff. I got an electrical outfit when I was eight, which was a present from my godmother. This was bells, buzzers and stuff, and I started wiring things up and at school, we had an optional lesson and I took my electrical outfit with me. I remember the teacher, Miss Freckingham saying, "Aren't you going to electrocute yourself?" I said, "No. It's only four-and-a-half volts." She looked confused, so that's my earliest recollection. And then people say, "Who was it that inspired you?" Well, the person who inspired me is dead. His name was Mr. Birch. He was a next-door neighbor, and he was a radio ham. And his wife gave me his bag of valves, transformers and a book called "The

Manual of Modern Radio" written in 1933 by John Scott Taggart. And I read the book and started building the circuits.

Fairbairn: How old were you? You were eight year?

Saxby: No, I was thirteen.

Fairbairn: Thirteen by now?

Saxby: Twelve/thirteen. Thirteen. So eight was the electricity. Thirteen was the radio and valves, right? And a little bit beyond Ohm's law. And one of the things I always loved was music. This was the '60s and it was Manfred Mann and it was the Rolling Stones and the Beatles. I had a reel-to-reel tape recorder and a germanium transistor radio. I built a transmitter, which was completely illegal. I had it in my shed, and I transmitted my own radio station, so I could listen to music as I walked around the town. This was before Pirate radio. Pirate radio came after me. I remember honestly coming home, walking with my friend, with my transistor radio, listening to Manfred Mann, "Five, Four, Three, Two, One."

Fairbairn: From your own broadcast.

Saxby: Yes, from my own broadcast and outside my house was honestly a green GPO detector van. And I rushed in and switched everything off, right? So I remember that. And then another little piece. My dad, you know, came from what you call a working-class background, my dad worked in a factory. And he was very supportive, my mum was very supportive, but my parents never owned their own house. They didn't have a lot of money, but they had a good quality of life. I found that I could repair radio sets and TV sets; I just did that for ourselves and then my dad would say, you know, when he had a friend that he met, "You want your color," it was black-and-white television then, "You want your television fixed?" I had a radio and TV repair business at thirteen. And my dad was the salesman, I was the engineer, and my mum was the technician. I had a very, very good business. It bought me all my records, all my clothes, and all of my stuff. One thing I remember very well is my dad had a friend, whose television was broken just before Christmas. And I rushed out and fixed it, and he gave me double money. So I realized the importance of timing, customer service, etcetera. So that's my heritage; that was my hobby.

Fairbairn: And brothers and sisters?

Saxby: I had a brother. He was the complete opposite of me. He was into the Combined Cadet Force, shooting and motorbikes, right? No interest in electronics whatsoever, but very, very good mechanically. I had a friend down the road, Chris Purseglove , who was similarly interested in electronics. And we used to transmit to each other and do stuff, he's a year older than me. He told me what electronic engineering

was. I was good at physics. Physics practical was my best subject at the school. Academically, there were people light years ahead of me, but I had a physics teacher who inspired me by, basically, we had to do practical work at home. And I got 23 out of 20 typically for my practical work, which made me top of the class, even though I wasn't top of the exams. I think that's, again, something about business. So I think that he was a really great teacher, by the way, this physics teacher He lectured at Sheffield University, he was a radio astronomer, his name was Jenkins, and I realize looking back what a phenomenal quality of great teachers we had in our school. Again, by the way, they'd all been through the World War II, and teaching was like their second career. We had people who were bomb disposal experts who did chemistry, made bombs. I realized the quality of our teaching was absolutely fantastic.

Fairbairn: How did the educational system work? You went through—what grade?

Saxby: It was called a grammar school. So basically, it was an all boys' school, and it was on the public school lines. In the UK that means the schools you pay for. And basically, you were segmented, you were taught to specialize early on. So early on, I dropped history. I dropped—what else did I drop, biology, fairly early on. But I carried on, I did Latin, I actually have O level Latin, and I haven't met many Romans, but I was in Italy recently looking at some stuff, and it was kind of useful. I did French. We did English, we did literature. But the real subjects I loved were physics, chemistry and maths. And I wasn't as good at maths as I was at physics, but again, quality of the teachers. The way the maths teachers taught us we did applied and pure maths. And we had this teacher, and he basically would say—we all had to do some work in the class. He'd say, "Hands up all the people who finished up to question 49." One guy would put his hand up, and he would say, "Hurst." It would always be Hurst. And nobody else had finished up to 49. He'd say, "All of those who haven't finished, finish at home." So he paced the whole class to Hurst. So when it came to actually doing the final exams, I did much better than we all expected, because he drove us, paced us to the best, right? So the school had an ethic of excellence. The other thing where I think has actually helped me in my working career; I was deputy secretary of the Senior Literary and Debating Society. Alongside me was a guy who went on to be a playwright. His name was Steven Wakelam who was the secretary and here was me, scientist, speaking alongside literary genius. I think that actually helped me. So in life, you know, usually engineers are shy. But having debated against this guy, I think that helped me. So, what I'm saying is I had a very solid good education. I can also tell you something else. I had a cousin whose parents were in the RAF, and he had money. And he was in a fee-paying school. He didn't get good enough A-level grades at the fee-paying school to get into University to do medicine. And he did an extra year at my grammar school, and he then got the grades. He said the teaching here is better than in the fee-paying school. So now, by the way, if I look at today, America/UK, this is kind of worrying. If I look at my friends, a lot of us, I think, have benefited from great teaching. So having done all that, I went to University, chose Liverpool. The reason why I chose Liverpool, was because it had a good department for electronic engineering. But more importantly than that, it was the center of rock-and-roll. The Beatles had come out of there. It was a fun city. It was on the coast. And I lived in the center of England, I wanted to go and get away, and so I chose Liverpool, and people have said of me that Liverpool is my spiritual home, and I think that's true. That's when I got away from home. Liverpool, again, great trading city. So that's where all the people left England for America, connections to China, and back. In the 1800s, Liverpool was the second richest city in the British Isles, okay? And lovely

houses, lovely architecture. And Liverpool, by the way, has the renaissance. If you go to Boston or Liverpool, the waterfront the buildings, look the same. They're actually designed by the same people. And you find that if you go back through the history, the first skyscraper was actually built in Liverpool. I can actually show it to you with a steel construction. So that's a bit of history, am I rambling on too much?

Fairbairn: No, no, no, that's exactly what we're looking for.

Saxby: Oh, we're doing okay.

Fairbairn: So, yeah, move onto the university time.

Saxby: So the reality. So I went to university, and for me, who had shared a bedroom with my brother at home I went to university I was in a Hall of Residence. This was in 1965. It was actually absolute luxury. I had my own private room [with] my own study desk and a balcony and central heating. I mean, so I went on a full grant. My parents didn't have any money, so I got paid to go to university to have another fantastic education. So all of us were pretty similar, right? You know, from all over the place. The community life and the social life, as well as getting my degree, which was okay. One of the things that I think really benefited me, I was President of the Hall of Residence at this place. And as a group of students, to get the best stuff in the Hall, we'd run dances. And we'd get the best dances, get the best music, get the best girls. You know how it works. And basically, we made serious money out of our dances. And we bought every block of the hall its own washing machine and tumble dryer made out of the profit. So, by the way, the Warden of the hall was a veterinary scientist. Great guy called Dai Hughes, who did a lot of work on research, special drugs. He, unfortunately, died recently. But he, again, was a fantastic influence on my life. So as well as the academic bit, I think all the other bits were even more useful. So lawyers, dentists, doctors, mixing with all the other disciplines, for me, personally, I think, at university, was more important than just academic qualification.

Fairbairn: So it sounds like you had some early business experience.

Saxby: Yes.

Fairbairn: You realized the value of profit.

Saxby: Exactly.

Fairbairn: With the benefits that that brought.

Saxby: And I honestly and truthfully, I think that goes back to the radio and TV repair business, when I was thirteen. I didn't go to a business school or anything. It was just kind of second nature. But also, doing a good job right. So not taking money for nothing. Actually, you got paid good money for a good service. Not, let's try and get the most money for doing very little.

Elliot: Money for value.

Saxby: A work ethic, really, I think.

Fairbairn: So tell me about your degree. What degree did you originally pursue. Did you ever change along the way? How did that evolve?

Saxby: So when you go to university, you don't really know—the reality is, I knew what I loved, and it was radio, television, all the stuff around that. That was my hobby. The first year of university was a very—it's almost like every subject we were not interested in was what we had to do. Mechanical engineering, engineering drawing, thermodynamics. I quite liked that. But it's almost like we did no electronics in the first year. And the reality is the final year of the university, for me, was the fun piece. That's only when we were doing what I wanted—what I liked. So two key things for me. We had to do a final year research paper. And I chose to do "Avalanche Breakdown in Silicon," and again, being better practical than theoretical, I got good marks for that. We had liquid nitrogen, we had low temperatures, we were doing all this stuff. That's something that was a highlight. And then the other piece, we had to do a final year essay. I chose to do for my final year essay, color television receiver theory, design and practice, 'Cause at this time, color television in the British Isles was about to arrive.

Fairbairn: So what year was this?

Saxby: '68.

Fairbairn: Okay.

Saxby: So it was '67/'68. And this goes back to the hobby. I actually did quite a good paper, and it was published in the engineering magazine. Then you're looking for a job, and the first people to turn up on the University Milk Round were the BBC. And they offered me a job on the spot for something like—my starting salary was 1,140 pounds a year. And the average salary was about £900. I think the BBC offered me 1,100 on the spot, which was a very good salary. But Rank Bush Murphy, where I went, offered me 1,140. So—

Fairbairn: Now was that per month, or per year?

Saxby: Per year.

Fairbairn: Per year.

Saxby: Per year, yes. This is—engineers were very poorly paid in the UK. So the other thing that happened at this time—so I loved my engineering. My first job then with Rank Bush Murphy was designing color television receivers.

Fairbairn: But this is with a bachelor's degree in engineering or physics?

Saxby: In electronic engineering.

Fairbairn: Electronic engineering. Okay.

Saxby: But there were two approaches to what graduates typically did. They would normally do like a graduate apprenticeship for a year or two. But because, of my final year essay, I'd done about television and stuff, and I could speak the language and talk the design and tell you the frequency of the sub-carrier and things like that, I got a real job doing real work without going through an apprenticeship, which is what I wanted to do ‘cause I tend to be a very impatient person. And that suited me very well. Now when I joined Rank Bush Murphy, they were a very advanced group of people, and the way they thought.

Fairbairn: Where was the office located?

Saxby: It was in Chiswick in London. And they actually designed the UK's first solid-state color television receiver and I had the pleasure of being involved. I was more the system's designer. But we were involved with integrated circuit design. And in my color television decoder, we had two integrated circuits. It was like custom design, telling them what we want. And they would actually do the layout with the rubies and everything. And these integrated circuits had 50 transistors and 50 resistors. That was state of the art. This is linear stuff, right? Back in '68. And I gave a talk at the Royal Television Society, called TV and Chips when I was 27-years-old about what I'd done and how it worked. And the other thing I put in was all the economics. Basically my talk was about the engineering, but it was also about look at the component count on the cost of this versus doing it with discrete transistors. Look at what we've saved in the factory and all. So that was all in there. Motorola Semiconductors were at my Royal Television Society lecture. They were just setting up in the UK. This was '74, and they were looking for people to hire and they liked me. At the time, I think I was on 2,300 pounds a year, as a senior engineer. And they offered

me 3,300 a year and a company car! Can you imagine? And I wasn't sure about joining the dark side of, you know, the commercial world, the American Semiconductor Company. The first job they offered me, I said, "No," to. And I went off and stayed in engineering. I worked for a company called PyeTMC, doing PCM regenerator design. This again, is linear stuff to get the pulses back to retransmit them further. And I was actually struggling financially. I was newly married. I had a car; I had the 35-mile journey each way to the work. It was a Ford Anglia 105E, and I had to set the timing to start it, and reset it to make it run. And it was tough. And Motorola was very clever. This guy called Jim Nott was still trying to get me to join them. He picked up the phone and said, "What color would you like me to order for your new Cortina 2000 GXL?" And I said, "White, with black upholstery." And I had a sleepless night saying, "What have I done?" The truth is, I never looked back. That was a big turning point for my career.

Fairbairn: Let's back up. When you were in university, did you study any semiconductors? You said you did some avalanche breakdown work.

Saxby: Yes, yes, it was very non-detailed. So what we had is we had—we did everything, right? So a little piece—so there was semiconductor stuff. But quite honestly, it was so minor that it didn't count. We didn't really do anything in any depth, apart from the research bit, where we could actually do something in depth. It was a general engineering degree.

Fairbairn: So coming out of there, you knew circuit design, you knew sort of how electronics worked, whether it was tubes or conceptually.

Saxby: Yes, yes.

Fairbairn: But you didn't have any formal detailed training in either one of them in terms of how semi-conductors worked.

Saxby: No, but the other thing I also did at university, so I did also programming—my first program was in Algol on an English Electric KDF9, and the program was to basically print out log tables of—sine tables, co-sine, whatever, with all the angles and all the degrees. And as I was saying to you earlier, the challenge was the formatting. I did a bit of that, did a bit of Fortran. But this was an undergraduate degree. But if I'm very honest, I think my hobby had more to do with my success than my degree, right? The degree was a ticket to a job. But the other thing is you look—again, my job was called on-the-job training. So the reality is I learnt from my fellow designers, and that's where you learn.

Fairbairn: So from graduation through '74, whatever you were doing, circuit design and TV in the context of color television and other things?

Saxby: Yes, and by the way, I did video design, I did color decoder design, I did EHT design, 25-kilovolts. I did everything, except the IF-strip. And I didn't do the tuner. But that was good and I loved it. The thing that was interesting, I think, where I was very, very fortunate was to touch integrated circuits and semiconductors when nobody else was doing that.

Fairbairn: What was the year that you actually got those first two chips that you put in that TV?

Saxby: I think it would be about '71, probably? The other thing, I learnt a lot about production, and test gear. So you'd go to the factory, and I also learned something about marketing. And it's a bit cynical, really. We designed the—one of the things about the old color television decoder with the variable AC color signal, the linear integrated circuit that was going to replace that was going to have a DC signal, and actually to control the amplitude of the color, which is the saturation. It had a DC signal; it didn't have a variable signal. And that's the way it was designed. The marketing department told me I had to make it work the old way when it wasn't designed that way. And I told them it wouldn't work. And they told me I had to do it. And I had to go down to the factory and prove it wouldn't work, right? And then they switched it back. So I learnt something about the need to get the specification right, and translate that through to the engineering. And I think that's one of the big learning curves about marketing and business and engineering, right? You've got to get the spec right. You've got to define it, then you've got to design it, and what you also know—but as a young engineer, I could not persuade them. You know, I said, "It can't do that." They said, "Well make it do that!" But I couldn't make it do that, but as a young engineer, I had a certain view of marketing right, which was not especially positive.

Fairbairn: Okay, so this talk that you gave about using ICs in television got the attention of the Motorola people. They eventually twisted your arm, dangled the car in front of you, had the keys in hand, and you made the transition.

Saxby: But the key, by the way, which I haven't really explained to you was my first job with Motorola, I went from being a design engineer to being a sales engineer. You see, that was the going to the dark side.

Fairbairn: That was the dark side.

Saxby: What a sales engineer was in those days, it was actually—my job as a sales engineer was to go around all the labs of all the designers, actually helping them with their designs. Getting them to design in the Motorola product. So my first year as a sales engineer, I was doing my own design work with Motorola components for all of the customers. And what actually happened—this is real life, I actually doubled my turnover when there was the world's biggest recession, because I got all the designing done. And I could almost remember in the first year as a sales engineer, how I really hated the commercial side, the negotiation, the purchasing and all this stuff. I was frightened of them. And I also didn't think they were

fair. You know, I was uncomfortable with that. But after a year or so, I sort of got through that phase of my life.

Fairbairn: But you learned a very important lesson at that point for the future, and that was the whole design-in cycle and the importance of that, and the time it took, and that sort of thing.

Saxby: But that's all I knew. So basically, what happened, when everybody else was getting fired, I was getting promoted. So Motorola promoted me you know, I was 27, no experience, they then put me in charge of the whole consumer—no, they actually put me in charge of the computer division first with customers designing computers. So I was learning very fast.

Fairbairn: Computer, microprocessor, or...?

Saxby: No. So if you look at how Motorola operated in the UK or Europe or anywhere, it was by market segment. So I started in the consumer segment. And because I was very successful, and they had a problem in the computer segment—and this was actually selling products to IBM—sorry, ICL, Ferranti and people like that.

Fairbairn: Oh, selling into the computer business?

Saxby: Yes, they took me out of my comfort zone, and put me into that. Now, I did then later get involved in microprocessors. So what happened is again, with the advent of the microprocessor in Motorola, 6800 and stuff, they put a lot of very technical people in charge, and they were very good technically, but didn't have a particularly good business sense. And I ended up running the microprocessor group, with all the engineers to sort them out commercially. And in this time with computers, you know, when they put me in charge of computers, I started reading about computers. And when they put me in charge of microprocessors, I started reading about microprocessors. I actually got into microsystems as well. But all of my stuff was commercially driven, but with applications engineers, design engineers.

Fairbairn: So what years were you selling into the computer business, and when did you make the transition to microprocessors?

Saxby: So let me work this out. So I joined Motorola in '73, I guess I was in charge of the computer division in about '78.

Fairbairn: This is computer division within the UK?

Saxby: Within Motorola UK, yes. And again, what I'm actually doing in my day job is I'm talking to the chief engineers, the technical directors of my customers about roadmaps, what we're doing, and the products that are coming out. And also attend things like Dataquest which was the big conference that everybody went to. And the guys would come over to the Data Quest conference and it was actually in Scottsdale, and this was going on. So the whole—my life was about working with technical directors downwards with future and roadmaps, getting products sold and designed in.

Fairbairn: So when did you make the transition to microprocessors?

Saxby: The brain cells are going here. Maybe '79 or '80, it's all very vague, 'cause I left Motorola in '84. And I'm in my—it may be that my transition to computers was a bit earlier. Maybe it was at microprocessors in '78 and computers in '76. Probably more accurate.

Fairbairn: So were there any sort of individual design wins or relationships with customers or whatever that really sort of were landmarks in either of those situations?

Saxby: So when microprocessors were invented, Motorola thought that the customers would be computer companies. And in fact, the opposite was true. They didn't want to use microprocessors. And part of my big success, our first big design win, was a gaming company, a fruit machine company, which actually called Barcrest in Ashton Under Lyne near, Manchester, that had done discrete designs with CMOS. And later switched to a 6800 microprocessor and had a phenomenally successful product. Improved their profitability. And I could remember going around this company with the Chief Executive of this company. His name was John. And he showed me his new building, and he says, "Robin, we've expanded into smaller premises." And the microprocessor had actually done that for him. That his inventory had shrunk, everything was automated, it was the same design for every product, because what actually happened was the software changed the product, so he had one design for everything. And it was changed through software. So I would say that was a major one. Another major one was a games company. It was called Videomaster—it had a game called Star Chess, which was about an intergalactic game competition, using a microprocessor. It was actually 3D chess on speed really. And this guy was very eccentric. His name was Cameron McSween. I dealt with many lively characters. And then we had another customer whose uncles were the Cray twins, East End London convicted murders okay? So we had some interesting characters to deal with who were phenomenal entrepreneurs. And what I realized was that the growth came from new markets and of thinking in a different way, to make new things happen. I think that probably had some influence on the way I thought about ARM. The other piece, I think, was the whole training from Motorola, an important discipline being market segmentation. And understand the needs of your customers, so you hired, in your applications team, people who had done design work for customers, if you're getting into automotive, you have people who've done automotive design. Getting the dialogue between the design side and the engineers with the actual application was important

Fairbairn: So looking forward, you had actually had quite a bit of experience selling microprocessors into embedded applications. That was your forte.

Saxby: Absolutely. That was—oh, I forgot to mention automotive. I talked only about the fun ones. The actual biggest design, wins in terms of money, were in automotive, engine control, dashboard display, stuff like that

Elliot: So you mentioned one thing, and I just wonder whether at the time you saw the importance of this, and that is, one design modified through software, could be hundreds of different things.

Saxby: Absolutely. So yes, is the answer. So what actually happened in Motorola, and I might be able to dig this out. Motorola had a sort of advanced education program. They'd send you off on these brainstorms, and put you through things. So basically people with high potential were treated very well, and you'd go off and analyse opportunities, and play business games. I actually wrote a proposal for Motorola to spin out the microprocessor division doing design services and I could say that the genesis of the ARM business plan came from that activity with Motorola. Motorola said they didn't want to do it. But I think I got a prize for the idea. But of course, they didn't support it. So I want to go through my filing cabinet and see if I could find that document. And I suspect I wrote that in about 1978 or '79.

Fairbairn: And were you were working hard in the UK, were you involved with any international work? Did you travel with Motorola?

Saxby: So I got a few promotions, so when I was in charge of the microsystems business, that was a European role. And I can tell you some fun stories about Germany and Britain. You know, there always was a bit of conflict there. But we got on very well. So the other thing about Motorola, even though I was working out of the UK primarily, Motorola had a very international view. So I would be visiting Phoenix and Austin for workshops, and looking at this market segment stuff. We really looked to the world. Also the factories were coming up globally as well. So at this time, Motorola was seriously investing in factories in Europe to support European customers. We had East Kilbride in Scotland doing CMOS and the microprocessors. We had Toulouse in France doing integrated circuits; it was a very fun time. All those people were quite young. You know, it was money going in, new business taking off like crazy. And in comparison to the culture of a British-type company, it was go-get-it-make-it-happen. It was very exciting. And Motorola promoted young people quite quickly. It was a great place to work, actually. So what I'm really saying is it was an international outlook. We operated globally, and created global views and perspectives by working together across the globe. Although the customers were in a particular place, we had a global view.

Fairbairn: And your major competition at the time in terms of selling microprocessors was Intel, I presume?

Saxby: Absolutely, yes.

Saxby: But then we also had Zilog, and we had Mostek appearing on the scene, I think Motorola had the best products, but actually failed, okay, in the sales and marketing, in comparison to Intel. And I think probably, you know, you learn how to get it right next time, after making mistakes. We did okay, but we should have done better. I was too low down in the organization to work out who was responsible for what. On the other hand, Motorola did very well in embedded control. Some of the people that I worked with at Motorola, John Stockton, you will know, who was at VLSI. I worked with later after starting ARM. I think people connections help a lot in creating the business success, those communications at a human level are very important.

Fairbairn: So let's finish up on Motorola. You were doing microprocessor and then Microsystems, and that on a UK-wide responsibility.

Saxby: No, no, this was European. By the time I got to Microsystems, it was European. And what we were trying to do was create another great opportunity that Motorola ultimately I failed to do. We had these things called virtual system VM boards, later evolving to Eurocard boards, and we had ideas about getting into the systems business. And I worked with all the people. But quite honestly, Motorola failed. I don't know why. To me, the opportunities were there. I think at high levels, certain corporate decisions were made not terribly smartly, and maybe some of the wrong people were in the wrong jobs. But that opportunity I can see it, right? But it didn't happen.

Fairbairn: So how did things end at Motorola? What was your exit?

Saxby: Okay, so what happened to me? So the reality again, with Motorola, I had great years there. And I got kind of promoted. The reality is if I wanted to progress with Motorola, I'd need to leave the UK. And I'm a great believer personally about you should work to live, not live to work, right? And I had a wife, two kids, loved the UK, good education, wife's a teacher. So do we want to go overseas? I did look, by the way. I was offered a job in Geneva, which I turned down. And basically, you get to a point where you say, "Hmm, time for me to move on." And as happens, you get headhunting phone calls all the time. So I had a headhunting phone call to actually be the Chief Executive of a security systems company. This is a really strange career move, but this company was the number one manufacturer of garage doors in the UK. They were called Henderson, and they had more than 70 percent market share of garage doors and to them, R&D was a new paint plant every 25 years. But because Henderson had all this cash, they decided to diversify, and the first thing they bought was this security gates company called Pitts Security Gates, which made sliding trackless gates. And then the next thing they bought was an access control company called Continental Instrument Corporation on Long Island, New York, who’s products were based on microprocessors. It was an electronics company and all the rest of it. Henderson basically got into a mess because they were mechanical engineers and didn’t understand electronics. They got these acquisitions, and things were not working out and they decided they needed somebody with an

electronics background. They needed a new chief executive for the security division to sort out this mess. And I got a phone call from the headhunter, and the interview went like this "We got all these problems, this stuff doesn't work in the UK, because the stuff was designed in the US, ," and there were communication problems and so on. "How would you sort it out?" And I said, "Well, I'd get a consultant in, we'd work out what's wrong, and we'd fix it." And they said, "You mean, PA Consulting?" You know, a big consultancy company. I said, "No, I think Dave Leiper could do that in an afternoon." And so I got the job. So here, I am age 37, the Chief Executive of this division of this company. I've got manufacturing, I've got gates, I've got all this stuff, but I've got a bit of a background in semiconductors, and I had to fix the problem. And I actually arrive, that was my first CEO's job, and there was a letter from the Special Branch, the police in London, saying, "Your gates have written off three of our police cars. What are you going to do?" And what had actually happened is spikes—the power supplies were designed in America. Not enough smoothing capacitors for the UK. And there were spikes on the mains, and it caused a flip and shut the gates, and ripped up the police cars. Dave Leiper solved that in an afternoon. Absolutely.

Fairbairn: Dave Leiper is?

Saxby: Dave Leiper was a colleague from Motorola where we'd worked together, who'd been in microprocessor group with me. Since he left Motorola. I think he was doing some consulting or something. And I rang Dave. So the next thing that happens then, so I have a vision with this security company, we've got security gates, we've got access control, we need a technical roadmap. Here's what we want to do. And we ended up hiring Dave Leiper to do the design work, building a team. But fundamentally, after two years with Henderson, I've got all these divisions of all these companies that we've bought, and I want to put them together and create Henderson Security Division, have a roadmap and do all this stuff. But my boss Norman Parker says, "No. Totally ridiculous! Never do that. Keep them as independent companies, that's the only way to make it work." I was incapable of putting over my point of view to Norman and he only believed in doing things his way. With hindsight, I'd say charm and bullying were his natural modus operandi. Anyway I left Henderson to join ES2. I got to ES2, because the ES2 founding Chief Executive was a guy called Jean-Luc Le Grand-Clement, who had been a senior manager within Motorola Europe, and he's setting up this start-up, and he picks up the phone and he says, it's literally like this, my secretary says, "There's a Frenchman on the phone, and he sounds a bit like Inspector Clouseau." "You heard about our company? You want to hear some more?" And so I say, "Yes." So what was fantastic about European Silicon Structures was it had a team of top Europeans together to do something really different and it had the background of Motorola, TI, and National. There was a guy called Rob Wilmott, ex TI, a guy called Bob Hiekes ex Motorola and National [Semiconductor. And the idea was using a Perkin Elmer Able 150 machine, we can make direct write on wafer chips more cost effectively than by using photo masks.

Fairbairn: This is E-beam technology.

Saxby: E-beam technology, yes. That was the idea, so it was a great idea. And they had an idea for raising money too. They're going to get the top European users of semiconductors to invest in the company, to get their custom chips. So seed money came from Olivetti, Phillips, British Aerospace and Saab. So there's fantastic vision, and a great idea, and I join them. Tim O'Donnell, our friend here, also joined ES2's sister company in the USA US2. He was at National, I think, at the time. And it was like, "We're going to do something. We're going to create a fantastic startup in Europe. We've got a great idea! We can do what the Americans have been doing for years in Silicon Valley from a European footprint." So I got out of Henderson

Fairbairn: What year is this now? You left—

Saxby: I joined ES2 in '86. Okay?

Fairbairn: And it was just getting off the ground at that point?

Saxby: It was—they hadn't gotten the e-beam machine working. They had just raised the money, they had this idea, they needed people, and what actually happened is I was interviewed for the UK Managing Director's job, but I was going to start at Sales and Marketing Director, because the UK MD was moving on. It was all a bit embarrassing, because I had two guys interviewing me and the senior guy wanted me to replace the second guy. So I came into ES2 to replace my boss, okay? It was a bit difficult. But anyway I join ES2. And we're doing—silicon compilation, a guy called John Gray, you probably know, started Lattice Logic, which ES2 acquired. The idea is we can take you from, high-level design to transistors, and make it so every engineer can just do it on their desk. Isn't that fantastic? Great idea! Bad news, the Able 150 e-beam machine had a tenth of the throughput of what the specs said. So it's actually a lot more expensive to use an e-beam machine than a set of photo-masks, and the business plan was broken. But some great people, some great pioneering…and some big mistakes.

Saxby: The factory was in Rousset in France. The software group was in the UK, Cadence actually bought it later on. I think Tim helped facilitate that deal. But again, I was actually the boss of Northern Europe, then I got put in charge of Asia, and I later was put in charge of America. So I was actually President of US2, which was United Silicon Structures. Just down the road here. And, "Hey, presto!" What ES2 did was raise a truckload of money very successfully, have a fantastic idea, fail at engineering implementation, then run out of money. And by the way, they ran out of money completely after I left and were bought by Atmel. So I then get a phone call about the creation of ARM whilst I'm the President of US2

Fairbairn: Okay, so you've had this career, you left the university, you went into color TV and related design, you then moved onto Motorola. You had a stellar career there. Security and then on to ES2. So

what was happening? Were you just working 24-hour a day what is your domestic life? What else were you doing? When did you get married? What was going on when you weren't working?

Saxby: Okay

Fairbairn: And what did your wife think when you said, "I'm going to go to this gate security company?

Saxby: Well, she knows I'm mad, right? I mean, so I think one of the things about me that probably is a little bit different, if I think the opportunity is right, I'll take a very big risk. So, by the way, when I resigned from Motorola to go and be the Chief Executive of Henderson Security, I got lots of job offers, promotions, and even when I was at Henderson, they kept coming back trying to get me back. They said, "Why are you doing that? You'll hate it, you know, you're a semiconductor man. This is not for you." I said, "I want to be a Chief Executive, I want to run everything, I want the P&L, I want the factory, I want the whole lot. I can't get this in Motorola. You're divisionalized. That's what I've got to do." My own definition of job security, is how easily can you get another job on the same money? Forget everything else. I realize, by the way, with the benefit of hindsight, working for the security company was the hardest spell of my life, because culturally, my boss was at the opposite end of the spectrum to me. I was strategic, long-term, road map, build a platform, go global. He was milk the profits, squeeze the numbers. He had more of an accountant's approach. Quite honestly, we didn't get on at all. He didn't have a high opinion of me or me of him. We were culturally miss-aligned. Incidentally, after I resigned, he took over my division, and shortly afterwards, retired of ill health at a young age of 48. For me he was the most awful boss I ever worked for, who really gave me the most impossible pain at the age of only 37. With the benefit of hindsight, I think without that pain at an early age we would have not been successful with ARM. Because with ARM, fights with shareholders, taking the company public, some of those issues, this guy called Norman, he actually taught me how to handle the most impossible tough situations. So I think I should credit him for teaching me the elements of “progress through pain”. That’s something I didn’t learn at Motorola. With Norman, I was out of my comfort zone. And so, I now advise young people to try something else to really learn. So I learned what I will tell you, by the way, about Henderson, where I really learned positive things was from all of the people who reported to me, like the guy who ran Continental Instrument Corporation, a guy called Stanley Wand, who was an MIT graduate, and a brilliant guy, doing all the electronics, he was a phenomenal guy. So I learned really good stuff from the guys who reported to me. It's just that I never had a positive dialogue with my boss. And what I realize in life, you know, there's different ways of doing things. And for individuals, you need to fit in the thing that's your culture, not somebody else's culture.

Fairbairn: Okay, Robin, you were just describing ES2. You raised a ton of money. It failed for engineering reality reasons. Pick it up there. Did you have to wind down the company? When and why did you exit out of ES2?

Saxby: Okay, so what happened at ES2? The people did a great job of raising the first round of funding. They did a great job of raising the next round of funding, and I went out there getting some new investors in, and stuff like this. The other thing that ES2 did for me, which was new to my career, was introduce me to Japan. So I'd never been to Japan, and I was put in charge of Asia. So ES2 started with a lot of overhead, and as the company was getting into more and more difficulty, you were doing more and more work for the same pay. So basically, it sounds like I had all these great promotions, but actually, I'm just getting more and more stuff to do, because the company's struggling financially. But for me personally, I'm getting new experience. And I particularly enjoyed my time in Japan, appreciating Japanese culture. We did get some Japanese investment as well. I think it was from Mitsui, if I remember rightly.

Fairbairn: This was the time that Japan was at the top of their game in terms of semiconductors.

Saxby: And they were very interested in what we were doing. You know, both the silicon compilation and the E-beam. And you know, had we been able to make the E-beam work, you can imagine what that opportunity might have been. So the other thing I can tell you that I really learned at ES2, which was quite painful, we were having to design end products that we hadn't proved would work, right, so we said, "We'll sell you these design tools. And we'll get the bugs out of them, and we're going to make it with this E-beam machine, and we will be able to make it work. And we had purchase orders and designs ready to go. And we had to get them into production. And I remember feeling personally very, very worried that if we couldn't actually make this stuff work, we'd put these companies out of business. And what we had to do to solve the problem, we had to go and get some photo masks, and actually—we actually did a mix—this is what the factory people did. We actually did a mix-and-match process, where we did some layers with E-beam, and some with photo mask. But again, somebody sent me an email just recently. Looks like some of this e-beam technology is now starting to be about ready for use, right? So the ideas of ES2 were good, it was just 22 years ahead of its time.

Fairbairn: The concept worked, it was just that the throughput and the financial reality weren't the same.

Saxby: So what I'm really saying is I had a sort of personal sleepless night about sort of over-promising and under delivering really. I didn't feel very good about that. And then the other thing that happened was ES2 had a sister company here in America, here in Silicon Valley, which was called US2. And it wasn't wholly-owned by ES2. It actually had some American venture capital in it. And I said to my boss, when I saw a report in from America, which I wasn't very impressed with, "If my most junior person wrote a report like that, I'd fire him." And he said, "Ah, you'd like to go to the US and be a white knight?" or something like that. So this ended up with me coming over to United Silicon Structures, which was seriously burning cash, which had in my opinion, some management which wasn't as great as it should be. And my job here was to actually cut the staff, and get the company to profitability. What I did practically was I said, "I want to meet everybody one-on-one. And I made some decisions pretty fast on who we get rid of and who we promote, and we did that. And we actually managed to get it to profitability. So while all of this was happening, by the way, we mentioned my family earlier. We'll come back to them in a minute. But

throughout my life, my family has always been stable where we live, because my wife was a teacher locally. The kids went to school locally, and my family would never move. They never moved to Cambridge for example. So throughout my working life, I've always been on airplanes. And what I've typically done is have the working week, Monday to Friday, twenty-four hours. And generally speaking Saturday and Sunday is family time. What I also try to do at a personal level is anything's that's very important for kids like the school play, or the nativity, or whatever, turn up that afternoon. So to manage the time carefully, in my opinion, you need prime family time and you need prime work time. And I would, generally speaking, try and do both, always a bit of stress. But that kind of worked. So the reality for me was it wasn't that I was desperate to get out of ES2. I could see that there would be a future job for me in ES2. Something was going to happen. What actually did happen, Atmel ended up buying it. And people carried on working. But what was clear about ES2, the vision of ES2 couldn't happen really. And really they needed a change of business strategy which was forget the e-beam machine and become more conventional. So I wasn't desperate to leave ES2, but at the same time I was traveling to the US, and what actually happened before the start of ARM was I got a phone call from a headhunter, Heidrick & Struggles, which apparently were the same people who got Scully to Apple, it turns out. Because I read Scully's book "From Pepsi to Apple" as I was talking to Apple. The foundation of ARM was Acorn had invented the ARM architecture. Their computer business wasn't really growing. It was the BBC microcomputer business. And if you had BBCTV programs, there was a market for you. But if you were outside of that, they weren't really going to sell their computers. The IBM PC was really starting to take off.

Fairbairn: What year are we now?

Saxby: This is 1990. So in the summer of 1990, I get a phone call about the idea of creating ARM from the headhunter. What is actually going on in the background is Apple and Acorn directors are talking to each other and there's a germ of an idea. Some of those people, I knew. So I knew Hermann Hauser from even before he created Acorn. He's an old friend. I've known Hermann since the '70s. We've skied together then. We skied together again recently, still saying how great it is that we can still have fun at our ages. So I knew of Hermann, because we were building custom designs for people and stuff. I think we'd actually built some test chips at ES2 for Acorn, and I'd read the papers about how great the ARM architecture was. And kind of everybody knows each other. So I knew that the ARM architecture was fantastic. I knew that the 12-man design team was fantastic. And there was an idea to create a new business. To be honest with you, I wasn't a big fan of Acorn. Acorn was owned by Olivetti. I think that they had 80 percent of it, and I got a bit of a view of European sclerosis if you like. But when the headhunter said, "Apple's interested in this," then my ears pricked up and I thought this is interesting." So I went to a meeting, and I think I met Larry Tesler. But I can't be sure. I met Malcolm Bird, who was the technical director of Acorn. And the discussion was about the idea of creating this new company. And the key discussion around here was, "What should the business model be?" And I think Acorn had already thought of the idea of licensing it, but they didn't really know what that meant. And we actually discussed in great detail about what I thought we should do, in particular creating a standard. I think Acorn had thought about the idea of creating a standard as well. And I said, "We have to be the global standard. That's the only chance we've got. Manufacturing is too expensive. I actually had a view that creating a

semiconductor start-up at this time would not be a good thing to do, because having worked through the semiconductor industry, we've seen the peaks, the troughs the upsides and the downsides. We know the amount of capital that's required, gets more and more expensive, the risk gets bigger and bigger. And the chances of success get less and less.

Fairbairn: So when you say your view was that it had to be a global standard, global standard as an embedded processor. And that was the view from the beginning, right?

Saxby: Absolutely.

Fairbairn: There was never a thought about trying to proliferate it as a processor in a computer system?

Saxby: So there was. I had Apple and Acorn who were computer companies. And they had an idea about what they needed. Acorn, in particular, wanted a computer roadmap to keep their products alive. But for me, it was blindingly obvious; it had to be *the* embedded standard. Okay? If you look at the early literature, it says, "The global RISC standard," because that meets everybody's requirements. And in fairness to Acorn, I think they would say, "Yes, being the global embedded standard is fine, but that's not your priority, mate, you know?

Fairbairn: Good if that happens.

Saxby: Yes, exactly.

Elliot: So how did you break that? Because that's what others did not do.

Fairbairn: I mean, get that, but so you're talking to them. When did you make the decision to actually step in and take over?

Saxby: So I think, well, I was the founding CEO, although I was not on the payroll. So basically, I think in about December, I said, "Yes, I'll take the job.

Fairbairn: 1990?

Saxby: Yes. The company was legally created on November the 28th, 1990. The lead engineer in the Acorn team was Jamie Urquhart. I accepted the job offer. There's a bit of a joke about this, about dollar/pound exchange rates, by the way. The initial offer halved my salary because the dollar/pound

exchange rate the wrong way round, until that got sorted out. But I said, "Yes, we can be a global standard. Here's how we do it." And the key was this were the founding investors, Acorn and Apple, who were the majority shareholders in this venture, the other shareholder, minority one, was VLSI, they basically said, you know, offered me the job of CEO. Do you want to accept it? And I said, "Well, before I accept it, I want to see if the 12 engineers actually want me as their leader." So what actually happened is Jamie Urquhart, who is the senior engineer in Acorn, and effectively the team leader for the spin-out, and Tudor Brown who became company President, met me at Heathrow Airport. I think Larry Tesler flashed past and caught Concorde, if I remember rightly. I think I shook his hand. And I had a meeting with Jamie—because I wasn't saying, "I have to leave ES2," and it was very obvious to me, this had been a team of 12, they'd been together for a long time, and I was the outsider. So I said, "Look, I've been offered this job. Would you like me as your boss?" And Jamie and Tudor both said, "We'd like you to meet the rest of the team." So while I was still working for ES2, I took Brian O'Connell who was my engineering manager of ES2, doing all the silicon compilation, all the transistors and stuff, to meet the 12 in the pub. We just talked to each other. What I was looking for, because this seed money, it was 1.5 million pounds, cash from Apple; 250-thousand pounds cash from VSLI Technology; and Acorn's intellectual property was valued at 1.5 million pounds. My view, having cut cost at ES2 and everything was, "How do we make this work with what we've got?" I met the 12 engineers, and I looked at them in the pub thinking, "Who can be marketing manager, who can be sales manager, who can be engineering manager, so we don't have to go and hire anybody, and can we make it work?" I basically, in that pub, decided that Jamie Urquhart would be Sales Director, Mike Muller would be Marketing Director; and Tudor Brown would be Engineering Director. I then decided that could work. After that meeting, the other thing that happened was I rang them up and I said, "Well, do you want me?" And they said, "Yes." And I said, "Is it unanimous?" And they said, "Yes." So I said, "Okay." So then I said to Acorn and Apple, "Yes, I'll take this job."

Fairbairn: Okay. So Apple, by the time you took the job, or before you took the job, Apple had already committed to use it, or they was this not yet a commitment?

Saxby: Larry wanted the processor. To get the processor, Apple Corporate wanted a company independent of Acorn. And before Apple Corporate would put the money down, they had to have found a CEO. So basically, I was the gating factor to Apple to put the actual money on the table.

Fairbairn: Okay, Olivetti had major ownership in Acorn, but never took ownership in ARM. Is that correct?

Saxby: Olivetti only had involvement in ARM via Acorn, although, many times they pretended they owned the whole company. At one stage they advised we were for sale. So now the interesting thing is, I was on six-months notice with ES2. ES2 was working out its future. And ES2 didn't want to let me leave to go to this start-up. And also, I wanted to be a global standard, so I thought it makes sense to stay friendly with ES2. They can build some ARM chips, and we learn together.

Fairbairn: And it's got all these major companies.

Saxby: So the deal I did with ES2 is that between when I accepted the job and when I legally joined them, I could work several days for ARM. And I could work several days for ES2 after joining ARM, and the days for each party cancelled each other out. So if you actually read the CV, it says, "I legally joined ARM on February the 18th, 1991," but in practice, everything that ARM did, I was in control of from the start. So Jamie Urquhart, as the lead engineer, sent me all the information via email, and I was very much in the loop. But legally, I joined ARM on February the 18,

Fairbairn: Okay, now go back to Dane's question, how did you break this knot, and when, between Acorn wanting a microprocessor for a personal computer, and the ARM an embedded strategy?

Saxby: What I did was I got the founding 12 engineers to do a SWOT analysis. And I show this in my presentations when I'm teaching the business class. It's a really good SWOT analysis. It was done in December, 1990. From that SWOT analysis, we worked out what we would do. Again, I can send you a presentation on this that explains it all. But basically, it said, "We have to be a global standard. We have to get into all of these markets. This road map for these computer guys, and so and so forth. So we came up with this strategy, which I sold to Apple and Acorn. They were totally comfortable with it. To LSI it was all this embedded stuff, that's your second priority. Your primary priority is to satisfy Acorn and Apple. And by contract, to set the company up, for Acorn, half the engineering resource in the first year was used to design an FPA, (floating point accelerator), which sold a total of 500 chips. That's hardly the basis of success. So what I managed to do with the Acorn directors and the Apple directors and Larry was one of the Apple directors, get them to buy into this strategy, and then let me get on with the details. So they never bothered me, but I managed them “carefully”, shall we say.

Fairbairn: So you did the floating-point processor.

Saxby: We had to.

Fairbairn: But all the development work on the processor itself was really aimed at the embedded market.

Saxby: No, what we did is we moonlighted. Basically, we were doing a computer CP processor, the ARM-600, and within the ARM-600, there was an ARM-6, which was the little embedded piece. So basically, the funding came to do the computer stuff, and we pulled out the bits that would fit the embedded market, and then what happened is we got income from the likes of TI. We went more in the embedded direction. So if you like, we moonlighted the bits we needed to get into the volume space.

Elliot: As a subset.

Saxby: Yes.

Elliot: For the 600.

Saxby: Yes, yes.

Elliot: But the 600 contained the floating-point unit.

Saxby: No.

Elliot: It was still a physically separate chip?

Saxby: Separate chip, yes. One of the things I've looked back at, and this is what I will send you from Dave Jagger is the thing I've just emailed you. What I got from Dave. Let me tell you the other piece, which was really very, very much me, if you like. What I said is, "We've got to get the voice of the customer into our roadmap. We've got to find the explicit needs of the customer, and come up with real solutions, and we've got to get that into the architecture. And when you read this piece from Dave Jagger, it describes the sort of examples that would come along; Nokia was a key design win. CISC processors had very good code density and RISC processors had lousy code density. Dave Jagger was the inventor of the Thumb instruction set, which is the 16-bit extension on the end of the ARM. And the realities, when I propose that to the board, because we had a technical advisory committee, I'd forgotten this, but Dave tells me that Acorn tried to stop me doing it. In fact, they even adjusted my bonus conditions or something, because they wanted their stuff for computing. But I'm not very good at doing as I'm told, right? I tried. So there was some classic, we were doing a bit of almost the skunk works to do the right things for the emerging market. The parents were never a big problem to me. I was always open, they always bought the strategy, there were never any fights, but we kind of got away with it, right? And if we'd done the pure Acorn roadmap, we'd have been dead within five seconds. And how that happened, again, Dave's got this in his article, the lead architect was actually a guy called Al Thomas, from a computer background. And he died, okay. So we were mavericks really. Yes, the engineering team were mavericks. We had no history, no pedigree. We just did the right stuff, listening to the customers, and we made it happen. The other thing from a commercial point of view that I was very keen to do, was realize that if we're going to be the global standard, which we wrote in the early strategy, "We would be in every market segment, except computing." There's no point in going head-to-head with Intel. We couldn’t win that battle. But we had ideas for automotive, mobile, security and so on - and we wrote all that down. Then we said, "Who are the lead semiconductor guys supplying those different markets. And who are the leading customers? Let's work with both of them, and let's get the voice of the customer’s, customer into the architecture, right?

What actually happened in practice? It was TI who really helped us win Nokia to get the code density right. It was LSI Logic with Western Digital and Seagate, that helped us get real time debug right for disk drive manufacturers, etcetera, etcetera. And that principle was established. Also when we were licensing, we didn't want two directly competing competitors into the same space. We were trying to become a standard and grow the market. So Wilf Corrigan will tell you this. Wilf Corrigan wanted an ARM license. And I wouldn't give him one, even though he offered lots of money. I said, "All you're going to do is compete with VLSI. When you can get me some new business, Wilf, I'll consider giving you a license." And he came back with Western Digital. We're still good friends. We chose our partners strategically. What we also did on the board, which was very good, Apple and Acorn helped me was to make a strategic decision on every deal. We'd say, "Here's where we're going to sign this deal with this customer. This is the strategic reason. Approve it, board." And I would say to the partners that we didn't sign, "I have to get board approval." So the way we handled that strategically was at a very high level, I think this was also part of it. Plus, the detail was the brilliance of the engineers coming up with real smart things to do, like real time debug. And they were thinking in a non-traditional way. I mean, Dave Jagger, how we hired him, he'd done a masters at Canterbury, at Christ Church University on the ARM architecture. We read his paper, interviewed him on the phone, and he flew over to Cambridge for his first job in his life, and he's got 30 or 40 pounds to his name. So we had no history or baggage.

Fairbairn: So was Apple then the first embedded win?

Saxby: I don't really consider Apple to be an embedded win. Apple's Newton is the same as a computer, really, except with lower power consumption requirements.

Fairbairn: Okay. So the LSI technology was the first semiconductor licensee, is that correct?

Saxby: That's correct. In reality, though, VLSI Technology was the company that built the first chips for Acorn. And in fairness to VLSI, John Stockton helped here. VLSI had been knocking on quite a lot of doors, like Ericcson, for example, but quite honestly and I'm not trying to be disrespectful, but VLSI, Apple and Acorn, all of them really, were in the computer space. And VLSI had an idea, we wanted to do all this other stuff, but didn't really know how to implement it.

Fairbairn: I think there were people within VLSI who had a clear view of what they wanted to do.

Saxby: But it never happened at the managerial level, no.

Fairbairn: But it didn't happen at a managerial level, right.

Saxby: That's where John Stockton, and people like that, people who really helped me. I embrace particular people with the right ideas, and again, within every partner, we had some great engineers. And some, who knew customers, had ideas, and had passion. In some ways, we energized their desires in spite of their company, if you know what I mean.

Saxby: In the partnership business model, the idea of the business model is working together, even though you're on opposite teams, you get a much greater result than the sum of the individual bits to be successful. I think we really embraced that. With the semiconductor partners, these are words. I don't know who came up with this, Tim? I think it was maybe Jamie, we said, "In every partner, we need two disciples. One commercial disciple; and one technical disciple." Plessey by the way, was also a great help to us. One of the things, if you read my CV, you'll see that I chaired a European Union research panel on microprocessors, called the Open Microprocessor Systems Initiative. And through that project, we got things like on-chip busses going, and other various things. Plessey put quite a lot of that in there. Basically, the success came from this little piece that's here, or this little piece of Digital there. This little piece of Apple, this little piece of Acorn, because Acorn did some good stuff as well. What we would do, was pick up the best bits, and just do it. The other idea, when we were making decisions technically, if we were to put something in the architecture, we'd say, "Well, they want this, okay? Which other customers will benefit from this, and by putting these features into the architecture, will this expand the attractiveness of the ARM architecture to be a global standard or will it detract? If they ask for things that were going to go in the opposite direction, we wouldn't proceed

Fairbairn: So the key elements of the design in the first place, the small die size, and the low power, those are what you built. Those are the key things you built on, right?

Saxby: What we inherited, from Acorn, in reality, was MIPS per dollar, okay? That's what we inherited. For Apple, a by-product of MIPS per dollar was MIPS per watt. Apple coming in on that, were an even bigger driver for MIPS per watt. I wrote personally the first company brochure, and if you look at it, it's got graphs of MIPS per watt and MIPS per dollar for ARM versus the competition. Everybody else was talking pure MIPS.

Saxby: Right? We said, "We're the best, and we're going to continue to be the best in these spaces, and that's part of our objective." We also said in that first brochure, we're going to make it easier for you to embed it, debug it, and all this stuff that makes using ARM easier. There was a system on chips design story as well as MIPS per watt, and MIPS per dollar story. By the way, at the time I was doing all this everybody's saying to me, "No, mobile products will never need RISC. You know, RISC processors, they're for workstations."

The other thing I should tell you is on licensing, I tried, because I was ex-Motorola, to get them to be the first new license company. Apple had a deal with Motorola, but they didn't want to know, right? So time and again, we were having an internal communications meeting about becoming a standard, I'd be having

a few interviews; what we do is we go and tell the story to everybody, and most people would say go away, rubbish, right? But we talk to a lot of people. One or two people respond, "Yes, I get it. I like that." And all you have to do is work with the ones that really get it and then the next one, the next one, the next one. If you look at the company history it starts with one customer, one project. Another big challenge was operating systems. There's only one operating system that ran on ARM. It was Acorn's RISCOS, right? So there were all sorts of challenges, but it was like, find good people, work in partnership, get something done, and move on.

Fairbairn: So you started with that sort of core premise of value, what was the first win, or what was the first one that you really celebrated and said, "Boy, this might actually work, you know?"

Saxby: Well, we celebrated all of them, of course. But they all turn out to be absolute dogs. You know, so the Apple Newton, the 3DO Multiplayer. All of our first customers had the same great vision as we did but they totally failed to implement. What actually happened in practice was fax modems, and I'm not quite sure where they came from, but they were one of the early successful products, right, that actually generated royalty income?

Fairbairn: Rockwell was a major player.

Saxby: Yes that's right.

Saxby: What I forgot to tell you was when we were setting up the company, I had a forecast from Apple and Acorn of all the chips they were going to buy. I basically said, "Ha, ha, ha. Joke, joke, joke." There's no way they'll hit those numbers. That was the other reason why I had to do this other stuff. It was pretty obvious to me that Apple and Acorn could never meet these numbers and it was all smoke and mirrors. What actually happens is that at different points in time, we thought we got some great design wins. We did. But many didn't implement well and there were failures. To get to royalty revenue is a long rocky road. I built a plan with a more realistic forecast. We quantified that to be the embedded RISC standard, we'd need to have two-hundred million ARM chips sold in the year 2000, By the time the year 2000 came, it was actually 400 million ARM chips sold, it's now 30 billion. And in the early days, it was much, much worse to get royalties flowing. The hockey stick, the time for it to take off was much, much longer than everybody planned. But the other piece of the business, which was the key to keeping the company afloat was the licensing revenue. So we'd get the upfront license fee, and the royalties would come later. We also sold tools and we did design consulting. So we actually were cash positive from about the end of 1993. Having run it very mean and very lean, we made a profit of 400,000 pounds in 1993. We were getting money from licensing. Another big deal for us was getting Samsung, because they had a lot of money. And we kept the company afloat with the licensing and the tools, until the royalties kicked in. And the royalties were really taking off around the time we floated the company in 1998.

Fairbairn: It always takes much longer than you suspect.

Saxby: Yes, but I kind of knew that. I mean, that wasn't a surprise to me.

Elliot: I think a lot of people see TI as being a really major win that set you off. On the other hand, I've often wondered about TI being significant in terms of turning revenue, both licensing and royalties, as opposed to Samsung, which was.

Saxby: So the reality in revenue terms, Samsung brought more early revenue than TI did. What Ti did was give us was credibility, and later on help grow royalty income.

Elliot: Right.

Saxby: So I think before the TI license, we were knocking on doors trying to persuade people to listen to us.

Fairbairn: When did that happen?

Saxby: I think we announced TI in '93 or '94?

O'Donnell: It was '94.

Saxby: The reality is the deals were done, and usually the announcement would come maybe a year later when there's a chip or something. So what I'm really saying is from about 1994 onwards people thought, "Hmm, perhaps ARM might make it." But it wasn't at all sure. I think up until '94, ARM hasn't got a hope, and you know, no chance. And then I think after'94 well, we floated in 1998, and by 2000, we were the hot ticket, really. That's kind of how it worked.

Fairbairn: So when did Samsung—Samsung came in after TI?

Saxby: I think they actually came in before.

Fairbairn: Before.

Saxby: So, and this again, was really rare. The other thing I'll tell you, I wrote in the original business plan at a strategic level, and I said, "To be a global standard, we need a partner in America." We'd already got VSLI. "We need a partner in Europe." That turned out to be Plessey. We need a partner in Japan. That turned out to be Sharp. I said, "We need a partner," and this was the order in which we had to do it in my original plan, "And we need a partner in Asia, not Japan." And I didn't say where it was. And what actually happened is it was VLSI Plessey, Sharp, and Samsung. And the difference between Samsung and the others with the business model, you could pay a higher front license, and get a lower royalty. Or you could pay a lower upfront license, and pay a higher royalty. The nice thing about Samsung, they're willing to put more money up front. And that was the turning point in terms of the resourcing of the company. When we had the Samsung money in, which was some millions of dollars, we could go out and hire some more engineers. About 1993, I think we doubled the size of the company from 30 engineers to 60. I remember that nearly killed us, because we had to deliver all this stuff to all these partners, and the 30 engineers had to train the 30 new engineers at the same time. For me, that was the most operationally difficult part of the company. TI also helped us. While this was happening, TI decided to shut down Bedford, which was down the road from Cambridge, and that's when we hired Warren East, who's the current CEO to run the consulting operation.

Fairbairn: So a key part here, we've passed over and that is the issue of royalties. Collecting royalties on an embedded piece of IP was an anathema to semiconductor companies. I'm sure you got a lot of just flat "Nos."

Saxby: No, the other key thing where I think ARM was quite good is in the legal agreement. We controlled the architecture well, we thought through the template for licensing, and when you were negotiated with us I explained I had to have board approval, a very high level of strategic thinking We discussed what's the right model, so you've signed here, you have to do this. And the other thing I should tell you, there's another important person. The first legal guy at ARM was actually David McKay, Acorn's legal counsel. I borrowed him for the first few months, part time, actually paying Acorn for his services, and then as the business started to grow, I said to Sam, "I'd like to get him working for us at the weekend. Is it okay if I pay him direct?" And he said, "Yes." And then I said, "We need to hire him now." So when you're setting up a business, you need the best people in every position, okay? At the start of ARM, we had no fulltime finance staff. I actually got ES2's finance department to do the P&L for me in the accounts. I got Acorn to do the legal stuff. And then we hired the people as we could afford them. So really, in the first year, it was just engineering, sales and marketing. There was nothing else full time

Fairbairn: Okay, but the whole royalty thing. I mean, you must have hit a lot of brick walls.

Saxby: Well, we didn't really, I mean, yes, we didn't get the royalty checks. They didn't pay us naturally. We had to fight our corner.

Fairbairn: No, but they agreed to pay royalty upfront?

Saxby: They didn't pay royalties up front but they did pay part of the license fee up front. That helped our cash flow. When they signed the license agreement they had to agree terms. That was all part of the negotiation, and we had a good template. And basically, we were prepared to say, "No," if they wouldn't sign to our terms, they had to go home. I mean, one of the other things I do remember personally, when TI first turned up to see all of us, we were a very small company. They arrived, and they hadn't signed the non-disclosure agreement. And they said, "That's our legal department. We're very sorry." And I said, "Well, I'm very sorry. Go home." They came back with a signed NDA. So even as a small company, we were quite tough. And I think a danger for any small company dealing with a big company, you got to get the terms right. And in the long run, that's going to work and that builds respect.

Fairbairn: I know that from my own experience, how difficult it was to convince people to take royalties. So I was wondering if you walked away from some deals, because people would not do that.

O'Donnell: Yes, we did.

Saxby: Oh, did we? Tell me about the problems we had.

O'Donnell: I remember we had our first interview, or discussion—

Saxby: The bit that I know about very well—

Fairbairn: So this is Tim O'Donnell.

Saxby: Okay, go ahead.

Fairbairn: And you hired Tim when?

Saxby: He was the first employee in the US as far as I only paid him for half-time work, but he tells me he worked full-time. Working out of his basement.

Fairbairn: In what year?

Saxby: '91.

O'Donnell: I called up Robin. Robin and I worked together at ES2/US2, and I left them when they sold off the division of the CAD division to Cadence. I went and helped integrate that division into Cadence's

and then I read that Robin had been made CEO of ARM. So I actually called him up the first day he showed up in the ARM office, and said, "Hey, Robin, when you need somebody in the US, I'd love to work for ya." And he said, "I don't know what I got, I don't know who I've got, or he skills I need, so I can't tell you right now." Later on, he was in the US, he still working for US—US2.

Saxby: I was in the US in February, before I'd left ES2/US2

O'Donnell: I mean, you were firing everybody at US2.

Saxby: Yes, and I met you by a swimming pool.

O'Donnell: Right, and we sat around and had a bunch of drinks.

Saxby: And he wouldn't go away until I'd offered him a job.

O'Donnell: I don't think you were offering me a job then.

O'Donnell: It wasn't until you got back. And you still made me go back and talk to all 12 before, and get their approval before that.

Saxby: Because I knew without their buy-in, it wouldn't work.

Fairbairn: So you started in '91.

O'Donnell: I started in '91.

Saxby: Quite early on. And he was—so the other thing from a board point of view, we got all this technical roadmap stuff, and they wanted me to go and hire some more engineers. And I said, "Basically, it's going to take as long to develop the business as the products." And I persuaded them that we should hire Tim instead of another engineer. And I think you came onboard about March or something.

O'Donnell: I think so, yeah.

Saxby: March '91, I would guess.

O'Donnell: Right.

Saxby: I think it was about employee number about 15, 16 or 17.

O'Donnell: Something like that, yeah. And at I first started working in the VSLI office, but then when I started talking to other—Semiconductor companies that was way too difficult.

Saxby: Right.

O'Donnell: So the first ARM office in the US was a downstairs bedroom in my house. So that's how we started.

Fairbairn: That's where all good companies start.

O'Donnell: That's right. Right. But getting back to the point, you were asking about the royalties. I remember we had a meeting with Motorola. I believe it was after Apple had announced the Newton, and Motorola, who had been a major supplier to Apple, wanted to get in on providing an ARM chip. So we went into the meeting with—I think it was Hector Ruiz. And so we were talking about our licensing terms, and we're getting into the discussion, and finally at the very end he says, "And of course, we won't be able to pay you any license fees, or any royalties." And we just kind of sat there with our jaw dropping. And, "Do you realize we're in business?" And so but he felt that because we would license it to Motorola, that that would be enough glory, that we wouldn't need to have any money. And we kind of walked away from that.

Saxby: So by the way, I told you, all these strategic deals came up to the board for approval.

O'Donnell: That wasn't strategic, no. But the interesting thing is he said, "Of course, we've got our own engineers." And I said, "Okay." And they had a processor at the time, I can't remember what it was. But it was some embedded processor they were working on.

O'Donnell: I can't remember what it was, the name of it, but I said to him, "Okay, how many engineers do you have working on that, and he said, "Oh, I think we've got 200 engineers. And I said, "Do you realize that the license fee you'd pay to us is quarter of what you're paying for the engineers that you have to develop this product that doesn't even have a market yet. And he kind of shook his head and—but he wasn't going to get down. So we walked away from that meeting. And it wasn't till two/three years later that Motorola actually licensed ARM.

Saxby: That's when Fred Shlapak was in charge.

O'Donnell: When who?

Saxby: When Fred Shlapak got Hector's job.

O'Donnell: Yeah, yeah. It's after Hector left.

Fairbairn: Okay, thanks very much, that's a useful addition. So I think, Dane, maybe you can step in here and sort of follow-up and sort of how they went from the first few wins that didn't turn out, to becoming the global standard, and the competition.

Elliot: Well, you said that it sounded like the fax modem was one of the early wins that was really successful, not hugely published, not hugely known. What were the first ones that really started to make sense. Not that ARM was necessarily publicly acknowledged as being in the design, but that the public started to become aware of the value of embedded computing, even indirectly?

Saxby: Okay, so from my point of view, it was one or two key projects. So the first project was the Apple Newton, and the supplier of chips was VLSI Technology, and the second supplier was Plessey. 3DO, I think it was Plessey and VLSI again. When we signed the license agreement with Sharp—and I personally was very involved in that negotiation—I went to Japan ten times in one year. That's ten months out of twelve. I remember Mike Muller saying to me, "We keep going back to Japan," they'd have more and more engineers, and Mike said, "It's impossible. We've only got 20 people in the company, and they've got so many engineers to keep seeing, we'll never close the deal. Sharp also had a partnership with the Apple Newton, but the key target customer for Sharp was Nintendo. Sharp was Mr. Nintendo. And they basically did it all for them. And it was the color Game Boy as the major design win with Sharp. With TI, it was Nokia. Their first product was the Nokia 6310. TI was a really revolutionary phone, and it was a worldwide success. It took Motorola's phone market share down. The Nintendo Game Boy and all of this and all of this good stuff that gave us worldwide recognition was happening around 1997/'98. We went public in April of '98. So basically, that's when the first wave of failures disappeared, and the real stuff started coming through. In other words from startup to real success is eight years.

Elliot: Wow, that's a long period of time.

Saxby: And then, of course, different segments take even longer. So something else I can tell you, so because I was personally very keen on Smart Card security, and secure cards. I was kind of probably pushing on ideas. And we bought a little company in France that was a spinout of TI. Can't remember the name of the company. But the Smart Card market was key down in Sophia Antipolis, France and we

bought this team. Then we invented this thing called “Secure Core”. This is a special flavor of an ARM core with some extra security in it.

Fairbairn: Special circuitry that went into the chip, you mean/

Saxby: Special circuitry and special software. It was a bit like a lock-and-key system. So this is an adjunct. So you've got the mainstream architecture, then you've got this offshoot. It uses the same stuff but with some special bits in. Security is different. For real security, you've got to have security in the hardware and software, and to do that you needed some expertise. So we bought this design team in France. And since I've retired from ARM, I retired from ARM in 2007, I got an email from Warren, the CEO, "You'd be pleased to hear, look at all this great success in Smart Cards" By the way, that's a really exciting growth market for ARM now. The time to that is probably 15 years, right? What I'm actually saying is the eight year cycle is the early ones. Further, if we look at automotive. Automotive now is very successful, but I think the gestation time to automotive was like 20 years. What happens is early fruit failure, some early adopters success, and then momentum kicks in. Again, if you look at the hockey stick of the 20 billion to 30 billion, it's actually ramping up and growing faster now.

Fairbairn: When did royalty revenue exceed license revenue?

Saxby: I don’t know if it does. I think it's about the same, Eric, isn't it? And we, by the way, said strategically, we want them to be about the same because the license revenue is selling the future. If your license revenue isn't similar to royalties, then maybe you're not inventing enough future products that are good enough. Strategically, we wanted to see them about the same. So the question is when did royalties get to the same level as licensing?

O'Donnell: About four years ago.

Saxby: Yes

Fairbairn: Can you just repeat that.

Saxby: Yes, about four years ago, licensing and royalty revenue were the same.

Elliot: And the approach now is to try to keep them essentially equivalent, because one says "futures," one says "revenue".

Saxby: I don't have a clue. I don't run the company anymore.

Fairbairn: But that was the view. That was the idea.

Saxby: That's the strategic idea. I mean, so one of the things that the local guys invited me to the ARM office this week to talk to them, and I had a great time talking to 250 of them. We were also taking about the partnership model. As you become more successful, your partners are doing more stuff themselves. And somebody asked me a question, you know, "The partnership model, how is it today?" I said, "It's even more important today than in the past, 'cause it's got more difficult. In a partnership, it's got to be a 50/50 partnership. They've both got to put in 50 and get out 50, and that's a good partnership. And you got to think about that hard, work at it, and bring real value to your partners really.

Elliot: In terms of partnerships, ARM has a number of different types of partners, at least from the external perception, the semiconductor partners.

Saxby: In my opinion, they're all the same. They just buy different things. The reality is, you have all levels of engagement of partners. So from my point of view, it's the 50/50 thing. What I think is very important in a true partnership business model is that it's balanced, and no one partner gets too strong a pull than the others. You need to listen too and understand everybody. I think the answer to your question is this: ARM has architectural partners who can do more with the architecture, but they pay more money for that. And it has implementation partners who just get something for money. And so I think at a strategic level, all partners are the same, but some do more than others. To be an architectural partner, again, it's a strategic decision, not, "How much money do I pay you?" It's actually, "Have you got the skill set to really do architectural stuff?" which means you need a team and all the rest of it. And the reality is there are only a few companies that can afford to hire such great teams like Apple, for example. The reality is there are different levels of engagement, but I think it's very, very important that strategically all partners are treated equally.

Fairbairn: One of the perceptions that I've always had was that you had partners with design houses who didn't actually produce chips. They did designs for other people.

Saxby: You're right. Okay. That's true.

Fairbairn: I always viewed that as a very successful strategy that nobody else played with.

Saxby: Okay, so you're absolutely right, and forgive me, I misunderstood your question. I answered the question "all semiconductor partners are the same," but with different levels of engagement.

Saxby: One of the things ARM talks about is, I actually said in a speech somewhere, partnering in multiple dimensions. So we had EDA partners, real-time operating system partners, tools partners, design

partners, special security partners. So and the term for ARM now is "The ARM connected community." That means people who pay some revenue, get some services from ARM, and the ARM I heard yesterday, the ARM connected community today is now past 1,000 companies. But we thought about that strategically in terms of, "What do you bring to the party to be a partner?" Rather than, you know, people talk loosely about partnership, when they don't really mean it. It's a loose alliance. A partnership is when you both really commit and put something in. You've got trust, it's a win-win, and it's fair.

Elliot: And strategically both partners are contributing.

Saxby: Absolutely. Otherwise, it's not a partnership. I think we were probably the first company to really define what a true partnership was. Back then, also saying "Who do we need? What skills do we need?" Again, going back to the early days of ARM with Warren. When we started the company, we did design consulting. Why? We were the only people who knew how to design ARM systems. The reality is from a business point of view, for a company like ARM you make more revenue and profit out of product than you do out of consulting. So at some stage, we say, "We're getting out of consulting directly. Who are the best consulting companies in the world, let's find a business model to engage with them, give them something, what do they want, what tools do they want. And we work that out." That also aligns to product. There's a development board. There's a piece of software. There are some EDA models. So in having the partnership, it also leads to the product strategies.

Elliot: Okay, one other partnership that is from my perception, a little bit different, is the one with fabrication facilities, like TSMC.

Saxby: Absolutely right. So that again, is absolutely correct. That is called the " fabless" semiconductor company model where the foundries become a strategic partner. That is the foundry partner model. So that is a subset of the semiconductor partner model. So all of those things are defined with names and products. And so there's a foundry partnership.

Elliot: And it sounds like there's a very overt recognition of each and every one of those classes of partnerships.

Saxby: Well, I'll turn to Eric now, as I've left the company. Do you want to say something about that, because you're more up-to-date than I am?

Fairbairn: This is Erik Ploof.

Saxby: He's Marketing Manager for the US. He's still employed.

Ploof: I think the key is that the partnership is really the DNA of ARM. As Robin said, the difference between just having a broad ecosystem and ARM's ecosystem is the level of partnership. So we certainly acknowledge the benefits and the value of each partner, and we develop the relationship in a way where we're engaged from R&D, all the way to the end of the product. It's really the ecosystem of ARM that has enabled ARM to become the underpinning of the entire embedded community.

Saxby: Very good articulate answer. Did you debate at school?

Ploof: I did. <*laughter*>

Fairbairn: I'd like to go back and see if when you took this job in 1990, what chance of significant success did you see for yourself and the company, beyond your own confidence? Were there any major turning points of, "Oh, shit, we're really in trouble!" Or, "My god! This might actually work!"

Saxby: From Day One, I really thought that we would do this. I really honestly thought that we would be the global RISC standard. And if you talked to Tim and Jamie and Warren when they had the interviews, I convinced them that I believed it, so they might say I was mad, but I believed it. I believed it because I'd experienced e-Beam machines that didn't work, ASICs that didn't work, software that didn't work, silicon compilation that didn't work. Standard products that wouldn't sell, that would go up in cost. I could see very clearly that the world really, really needed this. I actually thought in this 12-man team that has done from operating systems to transistors, only 12 people, and they can tell you how to get things to work, and the size of the cache architecture versus the core and so on. They had designed the whole Acorn computer, the compiler, the operating system, and the transistors. So with my industry experience, and what I can see, and this 12-man team, we can absolutely do it, right?

The other thing that I have to tell you which is an absolutely true story. I've always talked to my family. And my daughter was 11-years-old at the time, I said, "Katy, I'm thinking of leaving ES2, and at least I get paid there. This is a risk. What do you think?" And she said, "Dad, I've got a dice, and if you throw it and it says six, you'll be a millionaire." I threw it. It was a six. So I had that behind me. Now there were, serious low points. After I'd accepted the job, 'cause I hadn't been to a joint venture before, I went to see a friend of mine, Peter Smitharn, who was the Chairman of Schroeder Ventures, one of the leading high-tech venture companies in the UK. I said, "Peter, I'm looking at this opportunity, it's a joint venture, you know, I'd like your advice, please." And he said to me, "Don't take the job. Joint ventures never work." I said, "Peter! It's too late! I've accepted it." So what I would say was the hardest thing for me, honestly, was the conflicts between the joint venture partners. Apple wants this; Acorn wants that. The market wants this. In all honesty, that was, by far, my personal biggest stress moment. There were times when I thought, "Peter's right. Joint ventures never work." and to be honest with you, Acorn would try and get all the ARM resource to do all the R&D for them for free. You know Al Stein at VLSI quite well. He had other priorities for me. So those were the real pressures. And then there were real low points. We, in 1991, the deals were taking longer to close; we were running out of cash. The founding engineers had been promised by

their previous owners, Acorn, that they would have a salary rise in the summer. I showed the guys the numbers. To Harry Meeking, who's an expert on the C-compilers said, I said, "What do you think, guys?" "Clearly, we can't afford the rise. You shouldn't give them." We said, "Okay, what we'll do is when we got some money, I'll give you a back-dated rise when we can afford it, we did. We got the deal with Plessey and we gave them a bonus check for Christmas. It was very much a team spirit, so a low point was what actually happened, the reason for the delay in the money was that Plessey had agreed to the deal. They were taken over by GEC, and GEC renegotiated the license and that took another six months. So there were many of those situations, all along the way in the early days. But equally, we were very, very mean and lean, ‘cause I knew we had to preserve the cash. Another thing I did to get some VC money from Nippon Investment and Finance in case we ran out of cash. We actually never used that money. That was only 650,000 pounds, but it was there as an emergency. So I never felt, "We're not going to pull this off. There were low points. The other thing that happened is of the 12 founding engineers, I actually think Jamie Urquhart believed on Day One that we could pull this off. I think he was the only one next to me who truly believed this was possible. I think as time went by, the belief spread and new people came onboard, a sort of religion took off, didn't it? Internally, we, did you ever feel, Tim, that this wasn't going to work?

O'Donnell: I don't think I ever saw it as being as big as it turned out to be. I thought it was going to work, but our original plan was to be the technology provider for Apple and Acorn.

Saxby: That wasn't my idea. "We're going to be the global standard!"

Fairbairn: So that was sort of your own internal thing. What was, and Dane, you were involved here the competitive environment? You haven't talked about the competition. Who did you fear the most, and what was the competitive environment?

Saxby: Okay, it was huge. One of the things I remember, was that in Japan, one of the most direct competitors was AT&T with the Hobbit. I was in Japan, I think ARM was about 25 engineers, I was giving the keynote address and I said, "We're going to be the global standard." The boss of AT&T Semiconductors stood up, and he said, "I'm spending a hundred million dollars on, the Hobbit and everything, and we're going to conquer the world". We had Motorola competing hard with IBM and the PowerPC. The world was out there shouting what they're going to do with all this money. Right? I didn't have any money. When I came back from that, I actually thought, "My guys are better than his. We'll beat them, don't worry." We did. AT&T kills the Hobbit, and ends up licensing everything from ARM. So honestly and truthfully, I think that our 12-man team, were phenomenal, people. With Tim, knocking on the doors, just as important, just as phenomenal. But small teams can beat big teams every day of the week. Throwing a truck-load of money at something doesn't create a solution. Intel is huge threat today, still. There's always threats, Motorola, every major semiconductor company was a threat, and a worry. But my words were, "Turn your enemies into your friends." You know? Why should they fight you if they can make more money for themselves by collaborating with you? That was the idea. Eventually, the other

thing, I remember when we signed the deal with Rockwell, was another classic issue. We quite often find that top management wanted to do the deal with ARM, but their engineers didn't, 'cause it would put them out of work. What I would say is, "Get your engineers to do this on the side of ARM instead to make it more successful in this market. They stay employed. This is the win/win." That was the other key piece, actually management might think this, getting the buy-in of the engineers within the partner companies, and getting them to work together with the ARM engineers for a bigger win than just designing the same mouse trap to fail.

Fairbairn: Now, Dane, you were on the MIPS side. Can you explore that competitive situation?

Saxby: The other big threat, of course, was MIPS. So the same as AT&T, but MIPS, again, had a lot of money. Had processes. But the reality is, I think Hobbit was more in the embedded—we were looking more at the embedded market. And the other thing is, really, the competition was Motorola with all the CISC stuff. Right? The Japanese CISC processors. So in reality, I don't think MIPS was ever targeted at the same space as us. But as intellectual property licensing company. Now when you're negotiating a license deal, they're talking to MIPS as well, usually try and use that to get the price down in negotiating with us. But I don't think MIPS was ever a head-to-head competitor.

Elliot: I would agree with you. There was a perception that we should be, but in reality, we were never able to break the string of building computers, big, high-end iron. That was what the founders of the company saw. And the embedded world, which was really focused on MIPS per watt, never happened. The only company I was ever successful at doing that with was IDT. And IDT built a lot of embedded stuff with one caveat. Had to have a wall plug.

Saxby: Yes.

Elliot: They never had the MIPS per watt to put it into mobile. We always wanted the ARM marketplace, because we could see that it was huge compared to what we were going after. But you guys had focused on how to get there. And trying to sell that internally at MIPS was a battle. There was another, what I always viewed and I know a lot of my colleagues viewed as an opportunity missed, or maybe strategically the correct thing to do, when DEC went under.

Saxby: That was, that turned out to be a benefit to ARM. This is in the thing that I'm going to send to you. Where ARM was very weak was at the high end. We didn't have a powerful enough processor, and we didn't have the correct attitude these guys are good down here. They're not real men. They don't have big engines. We were short of resource. So when DEC came knocking on our door, and I think they had great architects, and great engineers, and great people. They did some analysis in markets, and thought, "What architecture is going to take off?" They came up with ARM, and we had meetings with DEC, where they basically said; "We can get you into the high-end space faster than you can yourself. Let us do it",

and they designed a product based on the ARM8, called StrongARM . DEC going under, for us, was a good thing because what then happened is all we learned on the StrongARM , we could then put into the ARM9 and ARM11. Yes, We got on very well with those guys, Rich Witek, and people like that, there was a real engineering synergy. At a high level, it was great, but it was the collaboration with DEC that was a leg-up for us that helped us get somewhere faster with products, we would not have developed because we didn't have the engineering resource. You probably know, some of those DEC people are now working for Apple.

The other thing is the realities to the ARM ecosystem, if they're good engineers, and they're working on ARM, and they get deployed somewhere else, there's a loss somewhere and a win somewhere else. So I think DEC was actually very, very important at a certain time. The other thing that I had hoped would happen as part of when Intel acquired DEC, they got an ARM license, that was another interesting story. But I was really; I really thought Intel should have used that. You know, if I was an Intel shareholder, I'd be very disappointed that they didn't do that, and they sold it off to Marvell. So I personally think Intel is the bigger loser than ARM there.

Elliot: I think retrospectively, we all see that. The interesting thing from the Valley's perspective when that happened, was we didn't ever expect StrongARM to go very far. It was on a boutique process, it was hand laid out. Didn't follow the rules at all.

Saxby: Sure, sure.

Elliot: And I think most people assumed it was just going to die gracefully as the volume fell off. But they went ahead and they completely re-implemented that architecture in a hierarchal structure with traditional design processes. I think we were all very hopeful that meant there might be a partnership here where Intel could move into the embedded world. Then they disappointed everybody, I would agree that they're the loser for this when they sold it off to Marvell. Marvell seems to be very successful with it.

Saxby: No, they're doing great. But you see, this again is, I'm afraid, this is classic of the successful companies, religion versus common sense. And it's a failing of human nature. We probably all suffer from this from time to time.

Elliot: So you would see Intel's moves as basically religious in nature, as opposed to common sense in nature.

Saxby: I'd say, you know, again, I was asked this question in the ARM communications meeting. One of the questions that came up was Intel's spend on marketing. And I said, "Why would you waste all this money, you know, selling money?" I mean, effectively they're offering to ship money with the products they're designing in. That seems like a path to failure to me. Whereas, what you want to do is build the

best products at the lowest price and the lowest power consumption and so on and so forth. So I'm not an insider to Intel. But I mean, look at the architecture what is now. ARM is now the most popular architecture on the planet. That's got to be really hard for Intel to swallow, I'm sure. But I respect Intel. I mean, if you look at their processing capability, Intel's got a lot of strength. What I'm saying to you, looking at it strategically as in the true partnership model, there's an opportunity for Intel and ARM to collaborate and get a win/win, right? And it would be interesting to see whether that ever happens.

Elliot: Well, if you keep up on the banter in the Valley at this point in time, there's a whole community out there that thinks that Apple's products with ARMs in them, should be built on Intel's advanced process. And there's another side of it, from the financial community, that says, "Intel's got all this capacity. And they're going to have enormously more." How will they utilize it?

Saxby: Absolutely.

Elliot: What are you going to fill those fabs with?

Saxby: Well, I don't disagree with that in perspective, but I don't run Intel.

Elliot: No, Paul does, and he's done a reasonably good job.

Fairbairn: Okay. So are there any more things you want to explore there? I'd like to sort of move towards wrapping up the things, but I don't want to miss any major points here.

Saxby: So one thing we didn't do, by the way, Doug, you, just to remind you, you started asking me about family life. Have I done as much of that as you wanted?

Fairbairn: I want to turn back to your personal life and experience, because we've spent all this time on ARM, but I don’t want to leave anything on the table significant in terms of the ARM experience, and then move on to the more personal, you know, talking about you, because this is really an oral history of Robin Saxby. Okay, so you came to 2007, when did you, how did you wind down from ARM? What made you decide that was the right time?

Saxby: So looking at life, I think I've said it earlier, that I believe in, love work, I love engineering, I love study, and I love academics. I love fun. You know, I love nature. I've got hobbies like I'm off to Yosemite, and I'll be taking pictures of birds, and I enjoy that. I ski. I love skiing! I play tennis. I renovate old radios. I've got a lot of hobbies. The other thing is in my working life, I've done a lot of, even though I was the CEO of ARM, or the Chairman. I've done a lot of other stuff. So I've been President at the Institution of

Engineering and Technology. I've been a visiting professional at Liverpool University for a very, long time. So even though ARM is an important part of my life, and I've loved it, and I still love ARM, I've got other stuff to do with my life. As a culture again at ARM, we always said that, you know, succession planning, two names in the box. If you get run over by a bus test, who's the next guy? I'm a great believer in planning careers, exits and timing. I had told the board, a long time ago, that by the age of 55, I wanted to stop being CEO. Because, I thought all this flying, all this dashing around, I'll be too old. It turned out that I stopped being CEO at the age of 54, and Warren became CEO then. I then said, and in the good old days of England, you could be Chairman and the CEO, but nowadays, the corporate governance people say a CEO can't become a Chairman. What a stupid thing to do if he's a good CEO and should be a Chairman, but that's corporate governance for you. So I managed to stay being the Chairman for a while. I wanted to exit from ARM, I basically in my head said, "By the time I'm 60, I want to do other things with my life," and the issue was I'm the founder of ARM, I'm the Chairman, I'm the name, if the Founder Chairman quits, you know, what happens to the share price? I actually thought this through quite carefully, and it worked a treat actually. So I became President of the Institution of Engineering and Technology, which is the biggest electrical/electronic institution, going back to just after Michael Faraday in the UK. And if you are Chairman or of President of this institution, it's only a one-year Presidential year, but it really is a full-time job. You're dashing around the world. You're doing, it's a great job by the way. So when I announced my retirement, I said, "I didn't retire and disappear." I said, "I've stopped being Chairman of ARM because I want to do this thing for the IET, I can't do both. But I will remain Emeritus Chairman of ARM So I'm still around to see the transition, and all the rest of it. And that's what we did. And by the way, on the day we announced it, the share price didn't move, so I consider that to be a really good result. For me personally, that one year of being President of the institution of Engineering and Technology was fabulous, because my working career has been electronics, it's been semiconductor industry really. And you know, when I was studying electronics, I thought all the power engineers were idiots, you know, Power and light current and heavy current. In the institution, I went around the world, I went to China to the Two Gorges Down, or whatever it's called, Three Gorges Dam?

Fairbairn: Three.

Saxby: And I met people who had done stuff. And I realized in that time, actually today the world is about power engineering, and saving the planet, and control. And I picked up a few hobbies, and a few ideas. So I worked out I was leaving. There was a succession plan. It all happened, and the stuff I wanted to do, I basically decided that what I do now is my life has become a series of projects, as opposed to one job.

One other thing I did, which was really completely crazy, which has been a big disaster, I funded the making of a movie. That's one of my mistakes. There's still hope. We've done the true life story of Marvin Gaye, but we can't get the music rights. So that's another little side project. That's one of my disasters. What I'd say to other people, you know, especially if you've been in a very full-on job doing two long-haul flights a month. Don't just go to the golf course. Plan your way out slowly. The President of the EIT helped me transition. What I now do is I angel invest, and I mentor start-ups. With my family, I've got my wife here with me in Silicon Valley. I'm learning how to be at home a bit, and spend time with my wife. That's

been another new learning curve, and I've realized that I was the boss of ARM, but I could never be the boss of home. I've had to adjust my behavior a bit, and try and improve. So I'm still on a big learning curve here. I'm very lucky I've got a great daughter, and a great son. My son did a degree in engineering, sorry, in music and technology. So I had a bit of influence on my son that at least I've got him doing something with technology. And we get on great.

Fairbairn: Yeah, and music, too!

Saxby: Yes, what he does, by the way, so his business is actually he digitizes digital assets. So I don't know if you know Kate Bush, she's a British singer, but she's one of his number one customers. And he puts up websites, and is doing shops on the web, and stuff like this, but his passion is playing in bands and stuff. So I get on great with him. We've got a daughter, who again, really interesting. Our daughter is clever; she's got a degree in Geography. And the reason she did Geography is 'cause mother did Geography, and was an infant teacher. And I didn't speak to her, 'cause I was traveling. But she then got an MBA, and she's working in the City of London, and she rings me up one day, she says, "Dad, I've quit my job, and I've signed into the Plumbing Academy, and I'm going to be a plumber. And I'm going to have my own business." Right? And I think, "What's she done?! She's got all this education!" Anyway, she's done it, and she's got a fantastic business. So in London, you got a lot of people with a lot of money, and they'd rather give the key to a girl to put in their new bathroom or whatever. Then the other thing I've done with her now, 'cause I've we're converting our house to alternative energy. We've put under-floor heating in, we've put in the control, and we got some solar thermal, we've got light-emitting diodes. And I've actually done a project with my wife and daughter. I thought I was the project manager, but my wife's the boss, and my daughter is doing the plumbing alongside me doing the electronics. I'm actually talking to my daughter, and I just wish, wish that my daughter had done physics, because I think she would love it, right? So there we are.

Fairbairn: And how old is she?

Saxby: She's 34. And she got married just two weeks ago to Mike, who is a computer guy. So again, my wife is the opposite of me, and Katy's the opposite of Mike. And we all get on great.

Elliot: It's not too late for her to do physics.

Saxby: She won't do it. Mike and Katy are going to be around here in December, and I'd love to bring Mike in here, he would love it.

Fairbairn: Absolutely.

Saxby: Yes. So I'm a lucky boy. I'm married to the same wife, still having lots of fun. And by the way, my start-ups now, I'm really passionate about. I want to tell you about Sontia, this is sound technology. It's amazing. And Plessey is doing some amazing stuff with gallium and nitride LEDs. Really very excited about it. So all these start-ups I'm helping have the potential to be the world's best. They might all fail, but they might succeed. So I'm really enjoying being engaged with all these things. If I was still doing ARM today, ARM's great, it's the standard, it's thousand this and that and the other, it's not as exciting as the incubation. And so I'm very lucky to be engaged

Fairbairn: So what is this company you're speaking of, what is the product?

Saxby: The Plessey one. Plessey, the second licensee of ARM, bought by GEC, almost disappears. Today, Plessey Semiconductors is a management buy-out, re-energizing Plessey, and the strategy is use the manufacturing facility that's there, that's been paid off. And get some great new technology that nobody else is thinking about that we can build. And they've got two things, in particular, they've got sensor technology, which is called an “EPIC” sensor out of Surrey University. And they're building it and shipping it, and making money, and it's going great.

Fairbairn: What kind of sensor?

Saxby: Basically, it identifies movement, it'll effectively do an ECG by holding two little things. So that's what it will do. And then the other piece of exciting technology. There's a guy called Professor Sir Collin Humphries at Cambridge, who has invented some gallium nitride technology to make light-emitting diodes that actually work in light bulbs, be a lot more efficient in terms of power, cost and everything else. And the good news is we've just gone through a round of funding, so we can buy some equipment to hopefully make it work. And I've got an advisory board meeting with them October, and what I'm hoping they're going to tell me how they've dramatically improved yield and everything is fantastic. For me, personally, better time with Plessey, better time with Sontia, better time with Liverpool University, I enjoy this more than, "Oh, it's another quarterly earnings statement, and the corporate governance brigade are coming up with all these questions," which I don't enjoy very much.

Fairbairn: So this company, Sontia, is?

Saxby: Sontia is a company in Sheffield.

Saxby: It's very, very small, and the idea is pure sound. If you look at Dolby details, all these things, they're not pure. They actually cause phase shift of the sound which the ear doesn’t like. The originator of this technology is a professional, is called Chris Vernon. He is a professional violinist as well as technologist, and he has invented some new stuff. It's actually DSP algorithms that can turn your lousy speakers into sounding amazingly magnificent like you're in a concert hall. The first customer is LG. LG

has committed to put it in every product they ship, so that's our first big win. We'd like to repeat the ARM story in the sound space. Whether or not we'll do it, I don't know, but that's the idea.

Elliot: It's a licensing model, too?

Saxby: Yep.

Saxby: I can tell you about another one. This is a tools company called IdeaWorks. The idea there is if you're designing code to run on Apple, or RIM or whatever, and you've got to move it and port it, design it on this common platform, and you can move it anywhere. And their big win is; they've just signed a major deal with RIM, because RIM is seriously short of applications. Whether or not RIM can make that work is still a question. But that's another one that I'm quite excited about. So that's a bit of software, that's a bit of sound there's a bit of gallium nitride and here we are in the Computer Museum.

Fairbairn: So you say you do some mentoring. For kids coming out of college, interested in technology, career, what's your advice?

Saxby: Follow your passion. So basically, I say to all kid—and again, I said this in the ARM communications meeting, I think one of the things you realize as we get old. I've been to a few funerals; you realize that our time here is very, very limited. I think very few people actually sit down and think strategically about, "What do I want? What's important to me?" Well somebody says, "You're good at this." So they sit at that exam, they get good grades, and they end up with a career that actually they didn't really enjoy it very much. I said again in the ARM communications meeting, I have a cousin who's 71, who is a medical doctor. And he says, "I wish I'd been a mechanical engineer." Well, actually, at the age of 71, it's a bit late. So my advice to the kids is really dig deeply. What really, really makes you tick? What really, really turns you on? What do you really, really love? What excites you, and then try and harness and work around that. Again, the classic one is, especially, this is one of the problems of education, and my wife's a teacher, one of the guys who just got the Nobel Prize for Physics, I think he was told he was useless at physics or something as a kid.

Fairbairn: Right.

Saxby: So I think within every human being, there is something that you can spark and ignite. As an individual, I think people can tend to be rather lazy. Take the easy option, don't think about it. But I think if you stop and think, write it down, really work it out, and follow your passions. I'd say, "Find the passion within you, really, in spite of what everybody else tells you. Try and find that." And the sooner you find it, the better chance you've got of having a, you know, I feel incredibly fortunate to be at my age, doing everything I want, skiing, playing tennis, bird watching, I mean, we're going to Yosemite, again, the work/life balance thing. If I were still with ARM, I wouldn't have time to go to Yosemite. So you know, I

think we're very fortunate to have those opportunities. And I think, what I say to the kids as well is, "The world is your oyster, you know everything is actually possible". Don't believe all the negative people," because people come out of nowhere and do amazing stuff! The other thing is, I say, "You've got to be the best in the world." You've got to at least aim to be the best in the world. Everybody says, "World Class." What does that mean? It usually means its rubbish. Okay? You've got to be the best, you've got to work out where you can be the best, and how you can be the best. Then you've got to work very hard. You don't get anything by being lazy, unless you cheat, but then you might go to prison. So if you want to be a reasonable citizen, you've got to work hard. And then the other piece that I'm learning is, you know, I've got involved with a few charities, and stuff. And my wife, by the way, does that. She sits on some boards of charities. You have to look at places like Africa, my wife's on the board of a charity in Togo. You realize how incredibly fortunate you are. We moan about our economies and everything, what I say is, "Open your eyes, guys and realize how fortunate we are, actually".

Fairbairn: Well, that's a great note to end on, I think! Thank you very much for your time.

Saxby: Thank you for the most probing industry knowledge questions I've ever had! Most interviewers don't know what they're talking about! But these guys!

END OF INTERVIEW

