



Charles Ewen

Interviewed by

Richard Sharpe

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Welcome to the Archives of Information Technology where we capture the past and inspire the future. It is Thursday, 18th August 2022 and we're in the middle of a drought in the south-east of England at least, and so it's no better person to talk to than the Head of Information Technology, the Chief Information Officer, the Director of Technology and the Senior Information Risk Officer of the Met Office. I'm Richard Sharpe and I've been covering IT, researching, talking about it, thinking about it, writing about it, since the 1970s. And Chris – Charlie, I should say – Charlie has a very varied background, which is quite unusual, because with the many people that I've interviewed in the over 200 interviews we've already had – not all by me – all the 200 interviews we already have on the Archives, we don't really have somebody with such a varied background already in his career. So, Charlie, you were born in the mid-1960s, where? Out in the West Country?

I was indeed. Thanks Richard, and hello. So yes, my name's Charlie Ewen and I was born in 1965 to pig farmers. My father was from Scotland and they moved down to Devon because he wanted to not be in Scotland, for reasons that are best left to him, met my mother and got married. She was from a family of coalminers from Widecombe-in-the-Moor and both part of a big family, and they got together to break through in their own right, they over time bought the land, because they weren't, certainly weren't from a privileged background, and set up a pig farm in a place called Okehampton in the heart of Devon, about as far away from the coast as you can get in Devon. And I was born the youngest of five siblings in 1965 to that farm and went to school in Okehampton at a place that had hitherto not recently past been a grammar school, a very good grammar school, but had been turned into a comprehensive, but was the beneficiary of a very good education as a result of going to something that had formerly been a grammar school but was now a comprehensive. So I went and had a comprehensive school education and...

Did you enjoy it?

... that's where it all started. I absolutely loved school. I loved school. I'm, I will say I'm not neurotypical, so I'm neurodiverse, that's a topic unto itself. But I struggled a bit with that, not knowing and not being diagnosed, I was a bit of an oddball, a bit of a loner, but I was very good at maths and I was very intrigued by

science and I was a very active sportsman. So yes, very much enjoyed school, it was lovely.

What about the sports down there, rugby?

Rugby and cricket, predominantly, yeah, and athletics, back in the day, a little bit of that. But rugby and cricket predominantly, continued to be involved in rugby and cricket just on the tail-end of being able to play cricket when they're really, really short and more on the sort of refereeing, coaching side of rugby these days, but not very much any more.

Okehampton is on the edge of the moor, is it not? And it's an army town as well.

It is. So it's got the army camp, Okehampton Battle Camp, I believe it's still called, and it's the place where these days they've got a big firing range, a series of firing ranges actually, up on Dartmoor where they test and train artillery people, and there's also Okehampton Battle Camp which is used by the Royal Marines as part of their basic training. So Dartmoor is both the best place in the world and the worst place in the world and so it's testing and as part of the Royal Marines' training they use Dartmoor to do some of that basic training.

Were your parents keen on your education?

Yeah, my parents were both, my father was very disciplined, hard working and was very aware of the privilege that over time they generated. So from very humble beginnings, but at the end they owned the farm completely, we lived, like growing up in the seventies, anybody that grew up in the seventies will say that it was an okay upbringing, we certainly weren't privileged but neither were we hungry, which many people were back in those days, and he was very conscious that hard work and discipline had got them to that place. My mum was very bright and able and kind of lamented the fact that she'd never had the opportunity for education and was very encouraging to all my siblings and myself. So yeah, there was nothing but support from our fantastic parents, they were fantastic parents.

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I interviewed one recently who came out of Wales, his father had been a miner, and his father said as he left, he'd gone to London or somewhere, you know, there's always a pick ready for you if you want to come back.

That safety net. And actually, joking aside, my parents gave me exactly the same safety net and success in their mind was not - they were full of great advice - but success was always success to you, it was never success by the measure of wealth or academic achievement or any other form of tangible achievement, other than, you've got one life and live it, is the contemporary phrase, and that was very much the - they didn't use that particular phrase - but that's very much the way in which we were all brought up. And, you know, I had a breakthrough brother, the next up from me, my brother Colin, was the first in the family to go to university and that was a big breakthrough thing and set a fantastic example for me to even see it was possible. I can say it now because both of my parents are dead, something I do regret - I haven't got many regrets in life - one of them was I was actually expelled from school whilst doing my A levels, which explains my, to a large extent, explains my strange journey through life to the place that I've got through now, was that the intention was to go to university and do maths or physics, the two things that I love most of all. And in the event that wasn't possible because the curricula, there was no national curriculum in those days, it was all done by study boards, as you might remember, and trying to find the right schools that could complete the last six months of my A levels with the study boards that we had just wasn't feasible. So my parents never knew this, my parents are both unfortunately deceased, but they never knew that I'd been expelled because one day some of my elder brothers who'd been in the services, one of them very successful in the Royal Marines, I'd decided, I came home from school and said I've had enough of this, I've decided to join the RAF. The real motive was because I'd discovered the only place that I could get both an education, or an education without A levels was the RAF in what you would now call a modern degree apprenticeship, but the driver wasn't actually self-motivating, it was because I'd messed up badly at school.

What did you do?

I probably shouldn't go there because all these people are still around, but I, my brother was serving in the Falklands and there was a memorial ceremony and somebody refused to lay a wreath on the grounds of their ideological views and I used that as an excuse to get more angry than I ever should and did some stuff I shouldn't have done. And the school principles, as I say, it was an ex-grammar school so the principles of the school were very, very high and you just didn't get away with that kind of thing. And, you know, looking back, it was the worst thing at the time that had ever happened to me and for probably two decades was the worst thing that had ever happened to me. When I look back at fifty-seven years old, or close to it, it's probably the best thing that happened to me. My, I happened to marry my wife, my current, my wife is somebody that I've known since I was eleven and went to school with me, she's very bright, she's a headteacher, now a lecturer in education at university, she says that Charlie, you know, you would have struggled at university because you needed that discipline that you got at the school that you don't get at a university. And at the time certainly you didn't have that discipline and it would probably have been a bit of a disaster in any case. So maybe she's right, and in the end I got to where I aspired to be, so...

Let's not pass over that lovely romantic piece that you've known each other since you were eleven.

Yeah well, it can be perceived in a good way and a bad way. So we're from Devon, as we'll get on to later, I've travelled very widely and lived all over the world, but nonetheless, I live back within ten miles of where I was born and I'm married to a partner that has known me since we were eleven, we were both fast-track kids back in the day at the school, top set kids. And yeah, it wasn't a childhood romance from then, in fact there were various parts when we were fifteen, sixteen, we couldn't stand the sight of each other, but we re-met up when we were about twenty-five and got married when we were twenty-six and we've been together ever since, just celebrated our thirty-second wedding anniversary. We've got three wonderful kids for whom we're both proud, and I'll give them a shout-out while I can, so I've got James, who's a postdoc researcher at Imperial College, and Sam who's a data scientist with one of the large consulting companies, and the youngest one does stuff in cybersecurity that I

probably shouldn't go into in very many details, and I won't even say his name. So they've not, neither of them, my wife's a maths and science specialist, so none of them have fallen that far from the tree. But, you know, the reason why I suppose it's worth it is both of our upbringings were very principle-based, we were very, very fortunate. I used to say that I led an unprivileged background, but actually, again, as you get older, you realise just how privileged it was. The only way in which it was unprivileged was it lacked cash, but it had everything else, emotional support and a place to go back to, and to your example earlier, a safety net was always there, it wasn't quite a pick in a mine but it was, you know, if all else fails you can always come home and work on the farm. And going through life with that kind of security and support was the biggest privilege of all, I think, looking back, and we're very conscious of that, and that's the same thing that we try and do for our kids is to, you know, go out there and do the best that you can so that you can reflect on achieving something with your life, but there's always a safety net and nobody else, apart from yourself, is ever measuring you.

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You seem to have inherited a massive drive from your parents.

Yeah, hundred per cent. Drive makes it sound pushy, pushy parent syndrome, and it's not like that. I really mean support and an early recognition that – I mean the phrase I love because it's the phrase that captures it perfectly however inarticulate or it is, is one life and live it. You know, very early on you've got one chance at this, so... and also all those great stories about, you know, life as a journey metaphor, you know, have an idea about where you want to end up and then try and make the journey there but it won't be a straight line and think about where you're going to camp out on the way and sometimes you're going to have to go south-east when you actually need to go north-west because that's what the terrain in front of you dictates. And those were the kinds of conversations that we've had, that I got from my parents, that I've had with my partner and that we have with our kids all the time. And, you know, I think life's tough when somebody else sets those goals for you, really tough, when somebody else is telling you what good looks like. And I've got lots and lots of friends from the background that I've got that still work at home on the farm, that

work in, you know, building, construction, whatever they might do, I've known them for a long time, in many ways they're much better people than me and I do recognise that it's, you know, I certainly haven't got a sense of superiority based on the fact that I happen to be working in a world leading organisation in a fantastic role.

You took this degree apprenticeship at the RAF...

Yeah.

... because that was the, the only place you thought you were going to get that combination of subjects which you loved and you excelled at. What was this disability that you had?

I don't want to go into that in too much detail because it's a funny thing. I've never had, I've had a formal diagnosis, but by mistake, of autism. So I'm autistic. That was quite late on in my life when I was about forty-five. What I did know as I was growing up was I – and it's easy to retrospectively slap your head and say well, it was obvious – but, you know, traits such as obsessive focus, almost obsessive focus and at the same time, an inability to focus on things that I knew I should be focussing on at the time. So, oh look, there's a squirrel syndrome. I'm quite easily distracted. I don't have much in the way of social empathy, so I've had to, you know, over time, without knowing that, you kind of recognise that in yourself and you think well, I struggle in situations where everybody else seems to know that I'm upsetting somebody and I don't. So over time, if you're perceptive, you see these things and you develop strategies to overcome them, which I've done very successfully. So, you know, I'm not in the neurodiversity gives you superpowers camp, but one thing for me that it's done is it's made me very, very self-aware and somewhat planned in terms of what outcome, or how I achieve the next outcome. And that includes the kinds of things that people find very natural, social interactions, for example. I have to plan those things and that sounds a bit contrived and maybe sinister in some ways, but it is me, I can't but almost – we'll come onto it – but there's a period in my career where I was a salesman and that life was really simple, because I had a load of stuff and a load of stuff to sell and I needed to sell it and I used to do things like call plans. That is quite a contrived world and you have to set out how you're going to convince that person or

that organisation to buy the thing that you're trying to sell them, and I absolutely loved it, I thrived during that period, because it was a really simple set of outcomes and a really simple measure. So it's all about developing strategies really.

Your strategies must be very successful because you're having to deal with a whole range of people and different circumstances at the moment. You've not only got inside the Met, but you – Meteorological Office, I should say. I told my wife, I'm interviewing people from the Met, she said, God, really? Are the police allowed to talk about that...

Well, we have some hilarious examples of where those two things have been mixed up that I probably can't talk about, but nonetheless, you're not the only one.

[00:14:09]

And outside as well. Now, your strategies must be really successful. There were times, presumably, where they weren't successful and they did break down, is that right?

Yeah, hundred per cent, and you know, going back to upbringing and principles, I think the recognition that the life, that the route to an outcome isn't always a straight line, in fact it almost never is a straight line, and figuring out over time what good looks like for you in terms of success or outcome professionally or achievement or technological breakthrough, I think, you know, being very clear on what it is you're trying to achieve is probably, if I'm a one-trick pony, that's my trick. I do, I work really hard to understand what the outcome is. So at the moment I'm the senior responsible owner for a 1.2 billion programme, GMPP, to deliver the next generation supercomputer for the Met Office in partnership with Microsoft, and in all that I am super-clear what my outcomes are. And I don't mean this disingenuously, but some of the best practice and modern techniques in project and programme management confuse milestone deliveries with the requisite outcome, and as I've already said, there are times when you might well miss some project or programme deliveries, or things don't go to plan, and so long as you've got that north star, that guiding light of super-clarity about what the outcomes are, then you're going to be okay, by and large,

because you're going to be able to get back on track to the thing that you want to do. And in my case, you know, obvious question therefore is, was your guiding light to be director of technology at an organisation like the Met Office, for which the answer is simply no. My guiding light was to make a difference, over time – it changed over time – to characterise it, when I was young, probably before and as I was married and we're struggling with money, money was a big thing and indeed, as we'll talk about, that drove my career for a bit. Then it became recognition became important to me and I wanted to be, okay, I think I'm pretty good, I want to be recognised by others as being pretty good, and that drove my career for a bit. When I joined the Met Office there was a sudden dramatic change, because to that point I'd only worked in the private sector where organisational outcomes are typically a straight line to money, the generation of, you know, fiduciary responsibility to generate value for shareholders was kind of it, that was the guiding light. Moving to the Met Office gave me a brand new dimension that I sit with much more readily, where the outcomes are very lofty in terms of improving the world within which I live, but are very tractable and deliverable. So the reason that the Met Office has been such a revelation for me is that as an employer I can't describe how much of a north star it is for me to do my little bit, largely to help others, research and scientists and so on and so forth, to achieve better outcomes in a way that actually does make a difference to the world that we live in, that's a fantastic privilege.

What was the process of your adoption and reaction to the discipline of the RAF?

Easier than I thought and easier than you'd expect. I was a bit of a wild child, I'm not shying away from that, associated with my terrible choices at school, you know, rugby player, cricket player and all that kind of thing. Again, the RAF describes a very clean set of rules and given my neurotype, that's really helpful, really helpful. You know what's going to happen, you know what to expect, you know what you're being asked to do. So actually, being told what to do in a formative period of my life was really helpful for me.

What actually did you do in the RAF then?

Oh okay, so I was something – they don't exist in the same shape as they did at the time – but I was a boy entrant, was what it was called when it was there, but turned into or was the apprentice programme, which ran in three, I believe, I might get this wrong, but I think there were three disciplines. There was avionics and electronics, that was me; there were radios and radar, that was also me because I was a – don't worry about it – there was a period, opportunity for me to double up; and engines and airframes, which was at a different place. And those are the three specialisms for apprentices of which the cohort entries were about fifty a year, from memory, but the attrition rate was enormous, so the graduating rate was twenty a year, something like that, or twenty an entry, I should say, something like that. So it's huge attrition rates because it was academically testing, but it was also militarily testing and somewhat psychologically testing for young people. I mean it was- and it doesn't exist any more for very good reasons, the world's moved on and there's all kinds of things that I look back on that you wouldn't have in a current world. I won't go as far as say bullying, I'm not going to join that particular camp, but it was challenging. So you had to pass all three aspects of the test: militarily; just resilience-wise, let's call it resilience; and academically, and it was tough. But for me it was the perfect, it was the perfect start in life and I was good at it.

[00:19:14]

Did you have to carry a rifle?

Yeah, we had to do the military stuff, I had to learn to march. In fact I, you know, we had a very successful display team, I was good at that kind of stuff, marching is something I can do. Shoot guns, I shot for the RAF. Yeah, it was all good stuff. It was all a bit in the background, certainly in the time. So the RAF was probably the least militaristic service. It was very technical even then, because at the end of the day you're flying aeroplanes and technical things. But yeah, there was definitely a healthy military component to it, and I look back on those times with nothing but fondness. The only reason I left was – how can I put this – it was definitely a school for the privileged, so if I had to mix the privileged with the proletariat, it would probably be seventy per cent privileged, thirty per cent proletariat. So thirty per cent of people like me had stumbled into it one way and another, seventy per cent of

people, it was a rite of passage for typically senior military people's sons, there were no women at the time, so it was sons and it was seen as a good thing that you went into the boys' entry scheme, did the apprenticeship, and that would teach you well before you too went on to be a senior military officer. That was a kind of lot of, quite a lot of people like that.

I didn't know the RAF was like that. I thought the Navy was like that, but not the RAF.

Oh, things have changed dramatically. And my visibility of what it was really like, I rose to the dizzy heights of corporal, so – and because the whole point of the apprentice programme, it was a non-commission scheme. There were straight on degree equivalents, so engineering officer routes. My brother was a big hand in that because they offered me that as well, however, my brother who was a serving non-commissioned officer in the Royal Marines said if you take a direct commission then you've got me to answer to, so that was a bit of a formative thing. His view was that to be the very best officer you need to experience life as a non-commissioned person first. Whether that's right or wrong, no idea. So I wouldn't like to comment on that versus services. Suffice to say, I learnt a lot and all of those things. I learnt a lot about discipline, I learnt a lot about resilience and I learnt a lot about myself in doing those two things, and I learnt a lot academically. It was a fantastic academic grounding. I won't – again, all these people exist – I wouldn't want to mischaracterise them, but the cohort that did ultimately graduate of about thirty of us, I think, of those thirty, at least ten of them have gone on to very, very high level successful roles in research or industry, and that's not by accident. It was a very solid grounding. More, you know, didn't walk away with a Masters or a PhD, and in fact in the end I walked away with an HND because the sponsoring university decided not to award the degree. So actually, my highest level qualification at the moment – that might change – but at the moment is a Higher National Diploma in electronics and avionics.

When did you meet your first computer?

Then, really. So then, so the training was – sorry if this is a bit geeky – but the training was all on the principle of the link to mathematics to analogue electronics. So you're learning how to do the maths to link Ls and Cs and Rs, inductance and capacitance and resistors in useful way of transistors, gates, to do useful things, that was kind of how the training went. And then as we came to the end of the training we began to realise that we would be born into an increasingly digital world, so microchips were already well and truly embedded in other areas and we realised that we'd been trained to do something that was probably superseded now by digital electronics and computing. Nonetheless, I'm very pleased that I was educated during that time because the grounding, I've never regretted not understanding the fundamentals of electronics and the links of core mathematics. I appreciate that, you know, would you sit down and try and build a TV using linear discrete components any more, no, you wouldn't it would take you a very long time and be very difficult. That said, broadly knowing how that's done has lent itself – and I see a direct analogue, by the way, to computing, so computing for many, not for researchers but certainly for the applied world and industry, computing is ever more abstract. Ever more we're consuming cloud-based services whereby you don't have visibility at the end of the line architectures because you don't need to, and you get to do amazing things based on the back of the kind of services from people like Google, AWS and Microsoft. That's fantastic and that's really democratised technology in a absolutely fundamental and dramatic way. And that's a good thing, as is the analogue of the digitalisation of electronics. It allows things to be done better, faster, cheaper, essentially. However, as you will know, underneath the covers there's still the old stacks of some description are still there and in my case in systems, that old school, if you like, old-fashioned education into how Ls and Cs and Rs work and the link to mathematics has never stood me in bad stead anyway.

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I've never been as deeply involved in electronics as you have, but I always like to remember that somewhere, some head must float above a surface of a spinning disc and pick out the information. That's what must happen at some point.

Yeah, yeah, quite. And, you know, we're probably getting a little bit ahead, but one of the key areas of work for me in terms of, if you like, technology strategy, or less arrogantly, sort of forward-looking horizon scanning, is this recognition of trend of abstraction. And when we get there we'll talk about what we're doing with the supercomputer at the moment, that's absolutely a manifestation of that. The days of needing to necessarily understand from electron movements and quantum tunnelling all the way – and the relationship – all the way through to how you might exploit a supercomputer, even in our very scientific space, that is abstracting. And if you consider a more industrial application whereby you might need to build a website, you need to move a structure to do it on, you'd be kind of crazy these days to set a server up and connect it to the internet and do all that yourself. I mean, unless you were doing it for research purposes, you'd be kind of crazy to do that. You'd abstract up to a service to do that for you and, you know, fundamentally IT comes down to computer storage and networks. So you manipulate, create data, you store data either short term ephemerally in short-term memory or long term in long-term storage, and you move stuff about with networks. And when you deal, as I've done through lengths of my career, with the people who are the, who have given birth to cloud-based computing, the hyperscalers, the Googles, the AWSs and the Microsofts, that's how they think. They really, really think that way because that's the commodity that they turn into services that people will pay for. And so sometimes it's more advantageous to look back from the future than it is to look forward from the past, and these are the, you know, that's often what these abstraction techniques need you to do, you need to think more cleanly about the outcome and the infrastructure required to achieve that outcome and less about all the constraints that, as an old person, I'm very familiar with and how you configure databases and how you might do this and you might do that and all the choices involved. Sometimes, starting with a fresh sheet of paper is both liberating and more effective.

You left the RAF, what did you do then?

So I left the RAF driven by our impending marriage. Can't remember quite whether we were married when I was still in or whether I was out, I think I was just about still in. So back in the day, you had to resign and that was quite a lengthy process costing quite a lot of money, so it took a couple of years for that resignation to go through. In

the meantime I'd served, by the way, at 216 Squadron at RAF Brize Norton operationally for a few years, working on TriStars from Lockheed, doing some really interesting stuff, and once again, lots of compute. So one of the parts of that, one of the things that plane did was monitoring using something that was unfortunately called the Aircraft Integrated Data System, or AIDS. So it was an early, it was an early manifestation of the ability to do things like proactive maintenance based on observation and data from what we now call the Internet of Things, to recognise, you know, digital twins, all these words are relevant, but it was the birth of putting sensors in unusual places on aircraft to pre-emptively detect things that might go wrong before they did go wrong, and it was a change of generation. Similarly, it was the first hybrid fly-by-wire and fly-by-cable plane, it was the first commercially viable wide-bodied jet. The RAF did some really interesting things that I can't talk about with it beneath decks, which were great for me as an engineer, so I got involved in some of that. And I got to fly around the world for six years, or five years, so it was a fantastic period of my life. And I loved it, however, there was increasing pressure for me to take a commission, to... so I was performing pretty well, and in the end I got posted to a research establishment in Wildenrath, which by the time I got there, the wall had come down, it wouldn't have happened anyway, but nonetheless I didn't know that at the time, and so I resigned because my view was I didn't want to get married and to be, frankly, live a military life overseas, that wasn't for me. So with much lament and regret, I resigned, not really knowing what I was going to do next.

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Had you done programming?

Oh yeah, yeah. But programming, again, right from, back in those days it was down to, you know, programming in binary directly to devices and then, you know, subsequently higher-level languages, and yeah, I've done a load of that. In fact, the next part of my career was very much that, so that was, I landed a job in a research position with Racal, who were subsequently acquired by Thales, defence contractor, working on some stuff that I won't go into any detail for, largely electronic countermeasures and communications gear, pretty cutting-edge stuff.

Where were you based?

Based at a combination of Bracknell, which interestingly is where the Met Office were back in those days - I didn't know that, well, I did know that at the time but it wasn't particularly relevant - and a place called Lyme Regis where, or Seaton actually, a very small village near Lyme Regis, where Racal had a kind of outpost, but which no longer exists. So I worked for them for a while...

Interesting company, Racal. Tell me about them, what was the culture of the company?

Again, I shouldn't, this opinion stuff back in the day. So Ernest Harrison, who was the Chief Executive, Chairman and variously both of those things at various times, it was, I loved it because it was hardcore engineering. It was old school, you know, for those of, so our vintage, think about what innovation felt like in the fifties, sixties, seventies, it was like that, it was genuine breakthrough stuff. And they supported that innovation very widely and they were very quick to take up on anything that had any traction. So something I don't see in the modern world anything like as freely as I did back in those days. If you were bright and you had a good idea there was always a means to get it, to forward that. It started to get more corporate, and this is just a personal view, and the big decision for me to leave was the day that - I won't blame Ernest Harrison - but nonetheless, the higher-ups decided to sell mobile phone technology to Vodafone and split off Vodafone, that was a sad day and kind of, I was tangentially involved with some of the things that had been, innovations that have happened around that and really, you know, people, again, I'm sure I've not got my history right, but I'm pretty sure that that sale of that technology was the birth of the mobile phone.

Oh yeah?

I'm not saying it didn't happen in parallel elsewhere, I'm sure it did, I've never studied to see quite... But they were a big contributor to that and I specifically remember working on something called the VOGAD circuit, which I remind people on trains still exists in some form, which was a Voice Operated Gain Amplification

Device, whereby you don't need to shout on a train, they'll hear you, trust me, the microphone will become more sensitive.

Yes. They made the first mobile phone call in the UK on New Year's Day – oh – New Year's Eve... oh crikey, what is the date? I've forgotten the date. I wrote about it moderately recently. And it was from Ernest Harrison's son to his dad, saying Happy New Year.

Yeah, correct. And I was around at that time, it was subsequent innovation done on the back of that, but the decision ultimately came to sell all that to Vodafone, that was sad. But that was a great time. In that time I came, another sad realisation that I was never going to be a world leading engineer. So going back to my north star, recognition isn't quite – I don't know if you're familiar with Daniel Pink – but Daniel Pink talks about, it's based on human motivators, and it's all based on decent research, social science, and he synthesises all of that up to three things people need are purpose, autonomy... purpose, autonomy and mastery. And I happen to subscribe very closely to that, that's me, certainly. They're the three things that I need. And I was never going to be a master as an engineer. I was an okay engineer, but my forte really was in systems engineering, which I gradually in that period got more so than the hardcore invention of a new way to do something from an engineering point of view. So I was an okay programmer. People would laugh at that and say, no, you weren't, I probably wasn't. But I was okay, passable. But I was much better, actually, at again the higher level systems stuff.

You left Racal, where did you go?

So from Racal, that was when I took a sales job. So I was, I got to the point where the combination of commute, various factors in my private life, my father-in-law died, we had our first child, I needed more money, I had realised that I wasn't going to achieve mastery as an engineer, despite that's what I really wanted to do, I was disappointed about that, and I was pretty unhappy and that was my first kind of real mental health hiccup. I was depressed and my wife was not, quite rightly, not standing for it any longer and said, you're not the person I married and you need to do something else, and put an advert under my nose one day for a sales job with a company called Farnell

Electronics in the north of England, in Leeds. And of course it was all, you had to be an engineer, so it was a sales job but you did have to be an engineer, and it was kind of the idea was that you would use your knowledge of the stuff that Farnell sold, a load of test equipment, a load of components, got lots of stuff, and you'd go into industry and you'd convince them of the merits of using that particular device. Sometimes that involved a free bit of design or a free bit of technical support or whatever, and I used to do quite a healthy dose of that. And then subsequently they'd buy the component from you and you were, everyone was happy. So that was the model and I was very- it's the most uncertain step I've ever taken in my life, I literally did it because I was going through a bit of a mental health crisis and I knew I had to do something and that was the thing that became apparent. So I went to an interview, they said have you got any previous sales experience, I said no, they said good, because we don't employ people that have got previous sales experience because you're going to join the best company there ever was, and to be fair to them, they were a fantastic company. And I went away for six weeks, and my first son was born during this six weeks, and I learnt all the, over the course of six weeks I learnt everything there was to know about that company, made some interesting contacts that might become relevant as we go on, or not. And then I was set out to run a patch in Devon. So I had to travel to Leeds quite frequently and other parts of the country for various things, but generally it was located in Devon, and I'd go out and identify all the potential parts of industry, Ministry of Defence as well, so it was anybody that I had to. Of course I'd taken on a book from somebody else who'd fantastically got deployed to New Zealand, I seem to remember, which was another attractive thing. And I did that for, I worked in that group of companies until I joined the Met Office, so for a very, very long time.

[00:35:56]

I'm going to really annoy you now and ask you, so what is industry in Devon?

Okay, yeah. No, good, good question. So back in the day – this might have been superseded in the fifteen years or so, twenty years or so since I had any visibility of it – but back in the day the industry in Devon was comprised of emerging tech, sophisticated technology in agricultural equipment, a lot of small to medium size

enterprises. There was a concentration of a few things that I can point to, there was just a lot of SMEs that were techy, of various sorts, but they grouped together. Process automation was a big thing, there were a lot of companies out here at the time doing process automation, so production lines for factories. And again, if you've not been involved in that, that was my most interesting, that was fantastic because that's where the physical world meets the world of technology in a really hands-on way and it was fantastic to see that. Really enjoyed that and nearly went into that as a career, it was so, I found it so fascinating. There were a couple of pure electronics companies, there were some test equipment companies, quite a lot of Ministry of Defence, so Devonport dockyards, a lot of work down there with the Ministry of Defence and other, various other places that I shouldn't talk about that I used to go and work with. What else did we have? We had a couple of full-scale manufacturers actually, there were a couple of large companies at the time that manufactured, A&P was one, from memory, there was a big – what were they called – Canadian telecommunications company that have since gone, but they were very big and I can't remember what they were called.

Nortel?

And they were based in Paignton. Nortel, yes, had a massive plant in Paignton, and they too were working, I worked quite closely... as you can imagine, because I was fairly successful, nobody was asking me what I did with my time, so I spent a lot of time in their innovation labs. Medical, a couple of major hospitals, all of whom at the time had their own R&D labs, so that was, because I had some background in that, I spent a lot of time with their R&D engineers doing stuff that I found interesting as well as ultimately in line with. So I was okay, in fact I was pretty successful, grew that area quite well. The thing that was happening alongside that though was the very, very early birth of e-commerce and the internet. So over time, because again, background – oh, by the way, at Racal I set up the first token ring network, so I'd always been the computer kind of amateur boffin. So, first token ring network that Racal had I set up and did a load of there, but they didn't have fulltime IT people, that didn't exist. It probably did somewhere but they certainly didn't at our site, so who looked after the IT? Well, I did, for what it was. But it was always all the way through, IT was becoming a thing in the mainstream, of course had been a thing since

the fifties in terms of research, but was becoming a thing in the mainstream. And so automation, people were getting rid of typewriters and getting word processors and all that and I was always the expert and in private life I've always owned whatever the technology has been and been a... so I had my own news groups and that kind of thing back in the day and set those up, and I did have servers at home and all kinds of esoteric ways to connect them to the internet and do all that kind of stuff, but that was a hobby really, as much as anything else. So that's in parallel alongside. And then, but the birth of the internet came along and I was fortunate to have the ear of the boss, was the way I put it, and I presented him with a proposition of the potential. So to characterise the organisation, it was high frequency, low value physical goods, that's what they were doing. And so the model in those days was to have a catalogue that cost an enormous amount to produce and to distribute, like an Argos catalogue, if you like, but same thing. And then call centres to support people who wanted stuff, that was how it worked. Now, both call centres, full of people, 2,000 seat call centres, full of people, they're expensive, catalogue production, expensive.

[00:40:00]

And I went to the bosses one day and said, you know, there's the potential to begin to automate this, and we started off life by producing CD, compact disc versions of our, a printed catalogue, that was where that started, and I ran that part of, very small part of the business. So more time in Leeds, more time with tech firms understanding how to do that, learning how to write things like Windows help files, I seem to remember, spending time learning how to do that, which was quite tough at the time. Contextual Windows help files are one of my major technical challenges back in the day. Finding people to work with the, that could develop the necessary development, and in doing so came across some really interesting people. I'm sure he wouldn't mind me saying, but Dr Ian Levy who's now the chief security officer for the National Cyber Security Centre, he was in this space. I worked with a bloke who was a direct descendant from Logie Baird that invented TV, and he was brilliant. So that alone, development of that was a fantastic time in my life. And of course, that matured over time, so once they'd have the catalogue, some people wanted to be able to order their goods via modem and bypass the [incomp 41:11]. So we invented and wrote technology in C++ and deployed Windows applications to allow people to get onto

our application and place orders directly to some servers that we had set up. Some of that used the internet, some of that didn't, it was all birth stuff. Ultimately – and I won't bore with every step of the way – but ultimately that ended up with what I believe to be the world's first plausible transaction website, what I believe to be. So it dealt with, because we had Ian, who I've already mentioned, and his knowledge of cryptography and development combined, the reason I say plausible was because we could handle credit card payment. Payment was always the problem back in those days and we had payment systems and adequate security which were based on mathematical principles that are still at the core, things like elliptical encryption, that are still at the core of modern security defences, because Ian Levy knew how to do those things, along with others. I'm being very disingenuous to a group of people that did this stuff. We had a development team, and over time I ran the IT team, and then this was all being done, again, alongside the main core business, which was about a 1.2, 1.1, 1.2 billion dollar business. It was listed on the Nasdaq as well as the, as well as the... it was an FT top 150 company, grown explosively by organic growth and we reached a period where two things happened. One, the company decided to grow through acquisition as well as through organic growth, and the other was the birth of the internet. And those two things are somewhat related so I got involved with both of them. So firstly, although I'd been with that company for a long time I did a lot of mergers and acquisitions. And I was doing the, I was doing the assessments and subsequently the integration programmes, and that's pretty – what's the word – brutal. Brutal is the word, because ultimately you've got a very limited amount of time to identify at a technical level the bits that you're going to crash together and integrate and the bits that you're not going to do any more, and the process areas where you're going to ask people to stop using the system they've used for fifty years and start using your system because you've been assimilated by the mother ship. And so I learnt a lot about change, I learnt a lot about the execution of transformation programmes, as you'd call them then – now – but you didn't call them then, during that time from that perspective.

That is a big challenge for your ability to empathise with people and also to, at the same time, be quite tough.

Well, I was learning tricks along the way. Active coping strategies might be a way to put it. I was always pretty – brutal makes it sound like I was a horrible person, I wasn't and I'm very open to people's feelings, I know all about them, I'm not Spock but I was relentlessly logical and relentlessly applying what you'd now call systems thinking, back then it was systems engineering principles, to the whole thing. So you can take the heat and emotion out of things, so standing up in front of 2,000 people saying I'm sorry, there's a call centre here, in two years' time there'll be 200 people in this call centre because we're going to automate the transaction process. I found that as a leader, slightly different dimension, the authenticity and honesty to which you do that will engender trust, and that's a big maxim for me from a leadership perspective, is that I always try to be honest with people. Moreover I always try to have, be authentic about the logic that underpins that maybe somewhat unpalatable decision. And that's a good thing. Doing that with a bit of empathy is also important and I've learnt ways to do that and make it, you know, I wouldn't march in and do that cold in the way that I've just described it any more. I might have done early in my career but not any more, because I've learnt strategies along the way not to do that. But a mistake that many contemporary digital transformation, typically programmes make, is (a) they're not clear about their outcomes, (b) they're not, they don't face up to the somewhat unpalatable systems engineering changes that are often needed, which are often process and organisation structure based, not technology based, three, they blame the technology when all that goes wrong. And I've seen that pattern repeated over and over and over and over again, and it's usually the tech... they'll end up labelling this as a failed IT programme and actually that's not true, it's a failed change programme which has a healthy dose of IT, because everything has a healthy dose of IT into it, and the problem is actually they were never clear at systems level about the overall heterogenous system with a homogenous perspective. So at some level somebody somewhere has to recognise that organisations and change within organisations are a blob, they're an amorphous blob and you have to find ways to unpick that using systems techniques. So what are the people impacts, what are the process impacts, what are the reward impacts, what are the motivation impacts, and part of that are the systems and infrastructure, the IT aspect. All too often these things are seen as IT projects, and they're just not. So I personally have refused to ever label any major programme that sits outside of the IT department, function, directorate,

whatever it might be, as an IT programme, because it never is if it affects a wider business. It's a change programme.

[00:46:28]

Right. Mergers and acquisitions is an absolute minefield, is it not?

Yes. I learnt a lot about corporate finance, corporate strategy, corporate planning, legal. So I don't profess to be an expert in any of those fields, but I can certainly hold my own at a board table when the topics come up, yeah.

From your mergers and acquisitions experience, what was the success rate?

In our case, well, success, again, how do you define success? Were there any train smashes? No. Were the opportunities fully realised? No. So, broadly speaking, very broadly speaking, and without going into specifics that might get me into trouble, because these groups still exist, broadly successful. Broadly successful. And I think that's because the higher ups, a bloke called John Hirst was the captain of the ship for a long period of this career, who uncoincidentally was the Chief Executive of the Met Office when I joined the Met Office. But John Hirst was always very clear about his outcomes and always careful to make sure that the companies of acquisition were a good fit, so they too would be characterised by high volume, low value, transactional. And we bought some companies that – I won't name any of them, because again, it wouldn't be the right thing to do that on the surface of things – so what the hell has that got to do with electronic components, and they'd be right to think that. But the vision was there in the higher ups, the board and John as Chief Executive, now the adjacency is all defined by that characteristic of high volume, low value, transactional. And, you know, the missed opportunity in all of that, to answer your question more fully, is the UK could have had an Amazon, because we were at points of this race – and I spent a lot of time in America, lot of time with Google and a lot of time with and around Amazon in San Jose and Silicon Valley, as it was back in the day - and I can assure you, or at least my honest and faithful personal assessment is we were very, very close to Amazon for quite a long period of time. We didn't quite make the brave pivot that Jeff Bezos made from books to other things, we didn't quite do that, and we

always tried to, you know, never quite won the strategic battle of, actually, it doesn't matter what you're flogging. If it sits in a warehouse, if it's relatively low value, if you're shifting it at volume, then it's core.

Okay. But strategically the company didn't realise that. Is that right?

Yeah, I mean parts. So, you know, companies don't think anything, companies are entities, they're mindless entities and they're a composite of people, it all comes down to people. Some of the people in some of the places lack that vision and it would be unfair to pull anybody out, but overall we didn't quite push – and this would have been about 19... 1995 to 2000, perhaps, that kind of, to put it into time, that kind of period, whereby the opportunity was there and before you know it, you know, Bezos and Amazon have done what Bezos and Amazon have done and it's kind of too late.

[00:49:38]

How did you ride the rough waters of Y2K?

Er, yeah, remarkably well. I was, I was a tangent, so in the end I was given accountability in a program that – John, if you ever listen to this will remember – called Fifty and Five, whereby the target was set to develop fifty per cent of the organisation's revenue over the course of five years from e-commerce and the internet. And that was a huge challenge, from a standing start, in a 1.2 billion dollar organisation. That's a big old ask, and we did it. And that, it obviously involved IT. But I ran a new team of people that were sat alongside IT, or as part of the leadership I should say, I shouldn't claim things that were- none of this stuff is solely me, by the way, at all points this has all been parts of teams of people that did these things, until we get a little bit further on in my career when I'm genuinely given sole accountability, that's a different story. But right here right now it was teams of people. And in that, the IT function took care of the legacy, as we'd now call it, and the e-commerce team, the e-commerce business did all the fancy stuff. And so we too did IT, but it was a different sort of IT. So I co-exist alongside IT. And to answer your question, it was the core IT teams that did the bulk of the work for Y2K and we approached it just the same way as everybody else, spent too much money on it,

probably over-exaggerated the risk, but nonetheless, when the day came nothing bad happened, so that's good.

[00:51:10]

When did you leave and join the Met?

That was 2008. So from 2000, which was for me the really interesting times of Farnell and the acquisition of groups and becoming a global organisation that was running in twenty-three languages in nineteen countries across the world, as a senior, as a growing leader, I played a bigger and bigger part in the corporation. So always from the e-commerce perspective, always from the IT perspective, but nonetheless, part of a senior, you know, growing my career as a leader, as distinct from an engineer. Probably that's the way to characterise it. And that became less and less compelling for me. I was earning a lot of money, a lot of money, but it became less compelling for me for various reasons, including changes of faces and new staff and new chairmans and new chief executives from 2000 to 2008. I also, because it had become more global, I spent more and more time – unknowingly at the time – isolated in the same place that I'm in now actually, which was a purpose-built office back in the day, and I got into another, my second big mental health problem, which was all caused by isolation and I had some really bad, much worse than the first time, but some really big mental health issues, largely – looking back – caused by isolation, whereby you can't, even in those days I spent a lot of time on a plane and I spent a lot of time international, I lived in all kinds of places, but actually, Devon was where my family and heart was so over time I thought, well, I could do a lot of this remotely. I remember gearing up two parallel five-frame relay connections into the shed here, which gave me unbelievable bandwidth, combined bandwidth of over a megabit per second, and I was really able with the technology, and made sure the other end could receive, and so I was remote working back then. But over time lost my mojo, is a good way of putting it, and that came to a crisis point really about 2006/2007, at which point I mentally made the switch, I'm going to do something else, I just didn't know what. And that coincided with John Hirst, somebody I already mentioned, getting his job as Chief Executive of the Met Office, a captain of industry appointed to chair the Met Office. And this is genuinely what it was, said, Charlie, you won't

believe this place, you need to come and have a look. So I went for a visit one day and got the tour and it was indeed fantastically impressive. What took my eye, I had no idea, I had no idea, as many don't, the sheer technological endeavour that goes into something like the Met Office, I had no idea. And when I saw these super-computers and I saw, I thought, oh God, this stuff's brilliant. And so I enjoyed my day out and went home, and six months later I suppose, I got a phone call from John to say we've got a job advert out that you might be interested in. It's a lot lower than your level, it was a head level role, which, I won't bore you with the hierarchy, but it was, that's two or three or four maybe layers down from the chief executive, when I'd become accustomed to being at that level. The money was a two-thirds pay cut from my base salary and no bonus, never mind a bonus, so in real terms, four-fifths pay cut. But it was to go and transform the Met Office's endeavour on the internet, endeavours on the internet, their public website was pretty much it at the time, in 2008. So I timed it well because 2008, as you might remember, was the big crash and I won't make political comments, but civil service pay has done what civil service's pay has done since 2008. But nonetheless I didn't do it for the money. And I went along because I was interested and walked out remembering thinking, I think I performed well at that interview, I think I'm going to get this job, how am I going to explain this to my wife?

[RS laughs]

[00:54:56]

Because I'd mentally – you know what it's like – I mentally have already made the decision in my head that if they were going to offer me this job, they did, and I was really pleased when subsequently I was offered the job and I had that difficult conversation with my wife who, once again going back to principles said, Charlie, if it means us going and living in the garden shed, then don't worry about it, we'll be fine. And I'd accrued some equity over the period where I'd been earning some money, so it wasn't, I'm not pretending to be on the breadline, I wasn't, but nonetheless it was a big change of lifestyle. And big decision, and it's the best decision I've ever made, because at the time I didn't know all this purpose stuff that I talk about and mastery, opportunities. I had no idea they existed when I said yes to the job. I said yes to the

job because frankly, I was in a pretty bad place. I'm just being honest. I was in a pretty bad place.

So we have military, we have the private sector, and now this super-technical civil service structure around you.

Yeah, yeah.

You, what is, in your opinion, since 2008, what is the culture of the Met Office?

Well, so, let's go back to those three Pink measures, if you like, I can talk about it in those terms. I've talked a bit about pay, that situation is very political and I wouldn't go there in something like this, but that's clearly an issue. Put that to one side, I'm not going to talk about pay any more than that, that is an issue. And it's a known issue. DDaT is the professional framework within the public sector for technology, so that's Data, Digital and Technology, it's well described, it's been worked up alongside the PCS. It converts and maps quite nicely to private sector analogues, but it's a very good structure and developing structure and just a quick call out, if anybody does hear it from central government, they're doing a fantastic job at creating a defined technology professional structure, really good job. But that profession is, pay-wise, is problematic. But moving on. At the Met Office, what's the culture look like? Well, the purpose, I've talked about it, it's the reason I'm there, it's paramount, the privilege, and it is a privilege at whatever job you do at the Met Office, to work for an organisation ultimately can and does make a difference to the world that we live in, is very recognised by all of our staff and very much me. It is a privilege and the work that we do in climate and the work that we do in attribution and the work that we do in the more short term in weather and the avoidance of risk and the realisation of opportunity is, it's a supreme privilege to do that kind of stuff and everybody's aware of that. That's the driving force. We then go on to mastery and again, I'm privileged to work amongst two and a half thousand – well – 2,200 people, I don't know the exact numbers but there's something like 900 PhDs in the organisation, something like that. And this sounds elitist, and I apologise if it sounds elitist, but the privilege to work amongst such bright people is a revelation for me, it's just fantastic to work amongst such an intellectual horsepower driven organisation.

And that's definitely a characteristic of the culture, it's a very bright organisation. So mastery, we've got people working at levels, fairly low levels seemingly, doing work that – and we can evidence this, unfortunately we have at the moment got instances of people leaving the Met Office to join industry and maybe doubling their salary and maybe tripling their accountability and dealing with all of that very easily, that's the opportunity for mastery. So, you know, even if you're not professor this or the director of that, we've got people that have – again, I see it as a privilege – they're working at levels that they'll never get the opportunity for. We do get people come back to us that leave, and that's the reason they leave, the reason they come back, again, not for the money, but they understand when they go into a different role and different organisation, they don't get to play with toys, frankly, or innovate to the degree that they ever could at the Met Office. It's definitely... So big ticks there. Working hard on autonomy. So this is the ability to understand the box in which you live, and whether we like it or not, we all live in boxes, constrained boxes, unless you're very, very... you happen to work in a role that gives you completely free rein, and they're pretty few and far between. Have we got those boxes right, ie, can people feel that they're autonomous, understand their outcome and are able to do whatever they need to do to achieve that outcome? Not quite. In some areas maybe, so some of our scientific research teams maybe have that. From a technology perspective, probably not, and we're working really hard on that at the moment in organisational design to try and create ways to make sure that people can innovate and create and deliver more autonomously, because at the moment, I have to say, there's an element of civil service bureaucracy at the Met Office like there is everywhere. The degree to which we can do something in the wider constraints of all being civil servants, I'm not sure, but we work really hard to try and work hard on that autonomy dimension. So, but the characteristic is that, really, a group of people that are very clear in recognising the importance of the work they do, the ability to do that at a level that few have the privilege to be able to undertake. Money's not great, frankly, and that's a eternal worry, and as autonomous as we can make it. And we're very overt, I mean you could speak to anybody at any level in the technology teams at the Met Office, they'll recognise what I've just said, we talk about it quite a lot.

[01:00:59]

How much does location in Exeter have an impact upon you?

Oh, interesting. So it did have a very positive impact and a negative impact pre-Covid. So in other words, what I mean by that is it's a big choice for somebody to move from the south-east, people talk about the London divide, I don't see it that way, I see it as the south-east divide along the M4 corridor divide, versus the rest of the country, more so than north and south, and more so than London versus the rest, personally. So with that in mind, it's a big step to ask somebody to come from anywhere to Exeter, because prior Covid there were limited opportunities to do tech elsewhere in Exeter. We talked about industry earlier on. Now that was changing all the time and Exeter is becoming actually quite a centre now for IT in various guises. So there's more opportunity to do that and that was growing before Covid. But frankly, you were making quite a binary choice. If I move from Reading to Exeter, that's a big choice. However, the plus side of that is it's a beautiful part of the world and many people, even pre-Covid, recognised that as a lifestyle choice. So that worked in our favour because – not that we ever relied on this – but once you've got them you tend to keep them, because of the limited choices. So that's changed a bit prior to Covid because of this growing technology scene in and around Exeter anyway, but Covid changed the characteristic completely. So Covid brings us into a world where most of that profession would expect now to be able to negotiate, we don't care where you work, nor whether you come in, kind of dimensions. So it's neither such a big choice to necessarily move to Exeter any more, nor is it such a constraining factor should you want to go and work elsewhere. And some of the, some of the increased attrition that we've seen post-Covid has doubtless been to do with the pay issue, doubtless. But doubtless some has also been to do with the fact that the friction that were needed to go and get another job, high paid job, still live in Exeter, if that's where you want to be, and get another job, has been dramatically transformed as a result of this remote working thing, within the technology profession particularly, post-Covid.

When you look at the use of computing inside the Met Office, the model was we have some of the contemporary biggest most powerful computers there are, starting with a

Ferranti Mercury and going through a KDF9 from English Electric, an IBM 360 195, a CDC, a Cray, etc, etc.

Yeah.

And we have it in our own glass box and we look after it and we do that. You are now making a radical move, are you not, and saying we can't sustain that any more. Well, I'm not sure what you're saying, I know you're moving. What is the reason for this move? Is it money, is it cost?

[01:04:08]

It's the conflation of a number of threads. So, let me talk about the alternatives at the moment. HPC, we never used to use the word supercomputers very much post-1960, we used to talk about high performance computing.

Okay.

And you'll be aware of the structures that define high performance computing into transactional throughput and the various flavours of that. High performance computing has undoubtedly been democratised as part of the general rise of the cloud, without a doubt. So there is absolutely high performance computing capability available as a service within the hyperscalers that I've talked about, and potentially others that I won't- I'm just going to talk about, when I refer to cloud, I will be distinctly referring to those three organisations as distinct from any other form of cloud. There's technical reasons that I'll unpack that at another time if need be, but that's what I mean. So that's undoubtedly true. So we've started to use the term supercomputing to define the particular flavour of HPC that is relevant for the particular set of ultimately mathematics in the Navier-Stokes equations, the dynamics of weather forecasting, the kind of workload that we've got. So we've used a different term latterly, supercomputing from HPC, gone back to an old word. And that's in part to do with trying to get people to understand why we don't simply run – and this movement has been out there for maybe, well, maybe close to a decade – why have you got an expensive supercomputer, why can't you run your workload on the

cloud. And many cloud advocates have been asking that question for a long time. And before we've been able to say, well because the cloud simply doesn't offer the sort of HPC that, the dynamics of HPC that we want. That's one factor. The other factor is around utilisation, which I won't go into too much, but one of the early attributes of cloud is elasticity and elasticity's based on the premise of irregular loads. So there's an economic argument more so than anything else, to say actually, if you've got a good loading, a good utilisation of something exceeding eighty to eighty-five per cent, then economically you might be better off running the infrastructure than you are renting the infrastructure in a cloud model, because one of the key reasons it's cheap on the cloud is the elasticity, the ability to only use it when you need it, so to speak. Coming back to it, there's a whole backstory about how Amazon got there, by the way, with AWS, but that's a different thing. So over time those factors are... they're dynamic and they change, and we've reached the point, we've reached a point whereby another economic factor, which is the ultimately economic factor, the degree to which in order to maintain approaching exascale scale of supercomputing, it requires so much of our limited resource that you have to question the proportion of the limited resource that it takes to do that versus other things, in a, let's imagine there's a – there isn't – but let's imagine there's a hard constraint. You've got 2,000 people, spend them how you want, zero sum game. And the proportion of effort and focus that goes into managing that, and not just managing the machine, but the successive, I won't call them lurches, because that infers bad things, but when you change supercomputer and you're operating at a very low level, obviously not only do you need to change the hardware, you need to change the software. So the physical models that run on the supercomputer can lead to some, at times, quite radical rework because of a different underlying architecture. And there's a general benefit to abstracting, if you can, because obviously you're not then asking a load of researchers to stop doing your research – it doesn't work like this, but nonetheless, in principle it does – stop doing your research, spend a year porting your code to this new architecture because we're going to get a new machine next year. The good news is, that once we've got that new machine you've got five years that you can exploit it before we do all that again. So, we're not here to talk about it, but we do have a programme of work, part of which is in association with collaborators like STFC and others, other people of our kind of mathematics in computational science which is based on LFRic which is looking to do just some of that. It's finding

ways to find, scientific ways to abstract a little bit and to what they would call separation of concerns, modularisation of monolithic codes, what I would call systems engineering. And it's the application of all that to these scientific codes, and you've got to bear in mind that these scientific codes, insidious, again, has typically bad connotations, I don't mean bad connotations, what I mean is a steady shift over time. So, the purpose of these codes has changed, you know, the birth of numerical weather predictions, you can pick a time, let's pick 1960, for want of a better place to point, back in 1960 these models were research models, they were helping scientists understand, develop their understanding of the work into the atmosphere at such time that a person could do a weather forecast. That's how it worked back then. And we can argue about when, because it's insidious, so it's, there's never a discrete point in time when this change happened, but over time, certainly, and let's arbitrarily put another point in time, I'll call it 2016, if you look back in 2016, the models have effectively automated many of those human judgements. So you've turned, the way we talk about it internally is the transition between a laboratory and a factory. So what you're asking for the supercomputer are two things now, you're asking for it to be a laboratory, to continue to develop mankind's understanding of the workings of the atmosphere, in the short term in weather forecasts, in the long term in climate predictions, but you're now asking it to also be a data factory. You're now asking it to relentlessly churn out data to help people make better decisions to stay safe and thrive, which is our mission. And that isn't necessarily best facilitated by a scientific machine.

[01:10:10]

So you've got to step back, we have to step back from this to get a good understanding. We're not there yet, we know we're not there yet, so our agreement with Microsoft, certainly in generation one, is that inside and under the covers there will still be a very recognisable supercomputer, the only difference being that we will no longer host and run it. And that was the contract that went to market actually, the contract that went to market wasn't some of the stuff that, the fact that Microsoft had been awarded [incomp], it was based on the premise that we no longer can own and operate this equipment, we will, others will own and operate. There were some circumstantial factors, one of those being available power in the south-west. You

know, you can imagine to route the kind of power, you're talking a fairly big power station to run an exascale machine and today's technology. We didn't have that fairly big power station at hand in ways that we could get from the grid in a resilient fashion, so we need it to be resilient, because again of its growing role as a factory. That just wasn't available to us in the timescales and costs that we had available to us. So frankly, there was no other choice, but to put this out to market. There were some hard factors with no other choice. However, it could have been awarded to a company that would have simply sited it somewhere else and would have run it in the same way that we always have done.

Yeah.

However, it was awarded to Microsoft, and so with generation one, that's still true. It is a supercomputer, it is a – I won't go into it – well, I can, it's in the contract. It is a Cray XC60 generation supercomputer, exactly the same supercomputer that's been implemented at Oak Ridge, for example, at similar scales, it's the same thing. In this case though, we do not own it and we do not operate it. Microsoft will do that on our behalf. That affords a new opportunity to further this general trend in IT of – because without doubt workload, the mathematics describe, infer a supercomputer infrastructure much like we've got with Cray definitely, so that's not going to go away. However, there are other workloads that are derived from that core mission, if you like, that core scientific mission, which are all about data factory. A supercomputer – let me use a metaphor – if you've got a Formula 1 racing car your tendency might be to use it for your daily commute and to go shopping with it. It will do those things but it's probably not the best machine to do it with, there's probably better machines out there. But if you've got one, then do it. And without pointing any fingers, in a very generic way, if I look across scientific supercomputing I can doubtless point to many examples whereby because you've got one, that supercomputer or Formula 1 racing car is being used for a daily commute and the shopping, as well as the thing it was designed for, which is to race as fast as it can round a track. So you talked about, you know, big supercomputers, they're generally measured in terms of flops. I've slipped into that language. Flops and exascale. We're at petascale at the moment, then move to exascale. And that's kind of arbitrary. It's kind of Linpack or whatever, however you choose to measure it, it's

just a test code that measures the raw performance of a supercomputer. It's a bit like – I'll go back to my Formula 1 racing car – it's a bit like saying, well, the engine's at the heart of a Formula 1 racing car, let's develop the most powerful engine we can and that's going to lead to the fastest way we can get around that track. There's a truism to that, but not entirely so. And for the Met Office, the workloads that we generate are purposeful, we have a very applied application, we know exactly what it is and we know exactly where we need to be bigger, and there are fundamentally a few ways you can spend, extra computational capacity. I won't bore you with those right now, but we can go into that at a later time if you want. And we know exactly the workload that we're trying to generate. And so for us it's nothing to do really with the size of your supercomputer, it's all to do with the performance and services that we can offer. Researching scientists do their research and run the data factory, they're the two dimensions. And that's not the same as the fastest possible supercomputer.

No.

And so there's a whole heap of workloads, but now, and as we get there, as we partition, separate the concerns in NGMS, our Next Generation Modelling Systems, as we understand better what data the outside world needs, because trust me, the models have equity, but you need a PhD in maths and physics to be able to understand what they're telling you, so the actual used data is not, typically not the models, it's typically derivations of the models of one sort and another, and there's a whole plethora of those. Geospatial paradigm data on maps, for example. Time series data, graph data, all of those data paradigms are relevant for the work we do. So there's a lot of post-processing, to apply a generic term, that goes on between the models and inside this data factory, the provision of data to help support decision making. That kind of workload, that's where the cloud, that's where we see the cloud as being our future, or certainly other forms of computing paradigms.

[01:15:17]

Why Microsoft?

Microsoft were awarded. That's as simple as that. So we set out these things, you can imagine, you don't get to have favourites when it comes to a greater than one billion pound programme inside government using taxpayers' money, you don't get to do that. There's a whole set of rules and regulations. It might not have been Microsoft, it might have been a supercomputer company direct, it might have been, it could have been anybody, frankly. It was Microsoft. That was before my time, so I was not the senior responsible owner for procurement and contract award, I am the senior responsible owner for the next ten years for implementation. So the fact that it is Microsoft is my world, more so than why Microsoft. Suffice to say, they won the competition.

An obvious question, which probably reveals my stupidity, but it was in a box in Bracknell or Exeter which you could have armed guards at the gate of, it is no longer?

Correct. And so that's a point, a facet of resilience. And I'm going to be super-honest about this, I'm very, very proud of the degree to which our teams keep our operation infrastructure live, resilient, cybersafe, physically safe, to your point, and all those things. Very proud of the way that we do that. Is that sustainable looking forwards? Again, it's part of that sum that says it's becoming too much of a thing when you start to think about the power station that drives it, when you start to think about the physical space it would occupy, and so on and so on, it all gets bigger, almost exponentially bigger, well, certainly early logarithmic development bigger, it all gets bigger. Do I have any concerns around security in any sense with Microsoft? Of course I do. Do they, are they very transparent about their resilience characteristics in terms of availability, security, cybersafe? Yes, they are. Do those stated, committed terms of engagement, contract if you want, pass our bar? Yes, they do. So, again, in any partnership, this is about do these people pass the bar, which they do, and it's not a question of whether I'm happy about it or not, it's not a question of whether I stay awake at night, of course I do. When I hear there's been an Azure outage I'm, my God, what's happened. Did we used to have outages in the past? Yeah, of course we do. Do you build resilience tactics and so on to make sure that those outages, which are inevitably going to happen, affect your throughput of workload, well, that's what we'll seek to do. And who are the masters of that

domain? Well, the cloud companies. So, you know, I'm not suggesting that our teams don't do anything but a fantastic job. Are we a Microsoft? No. Do we aspire to be a Microsoft? No, it's not our job. Our job is to do the fundamental research, the pioneering research to convert that into models that represent the future state of the atmosphere, to turn those models into useful data that can be used by operational meteorologists for advice and guidance to our users, and in datasets that help people make better decisions. That's changing too, you know, increasingly we live in an automated world, so increasingly our customers are things like machine learning algorithms, other people's machine learning algorithms. So the whole world's changing on the supply side, it's no longer – I go back to 1950, in 1950 the sole user, really, two users of our models were the meteorologists to help them make up, to help them describe a weather forecast, and our scientists to help them better understand the workings of the atmosphere. That was it, and maybe some collaborators in other organisations that do much the same thing. These days we've got billions upon billions of consumers all trying to do different things, some of whom are not people, some, a lot of whom are machines, and in the future I expect that ratio of machine users to people users to become ever more. Because although – and I'm not popular for saying this – this might be a good thing to finish on, by the way – but I'm not often popular saying this, but if you think about it, nobody really wants a weather forecast. To be slightly more correct, few people want the weather forecast. What people have been trained to do is to accommodate weather, which is almost ubiquitous in decision making if you think about it, almost ubiquitous, they're actually trying to make a decision and working with others - the Met Office don't aspire to do all this ourselves – but working with others and forming the right technology to accommodate it, integration with the Internet of Things, integration with a machine environment, our job, in partnership with others, is to answer those specific questions. They can be as trivial as, what's the best day next week to cut my lawn, right through to where's the best place to site a nuclear power station. They are specific decisions that need to have answers to and the Met Office and the information, the guidance that it provides us are part of that decision making process. Sometimes almost completely, so a use case might be a fighter jet. The fighter jet's on the runway, the weather's a bit sketchy, should I take this plane off or not, is almost entirely a meteorological decision based on parameters. So sometimes the decision is almost like a weather forecast, but oftentimes...

[01:20:33]

Well, we've got the famous decision about D-Day.

Yeah, quite. Yeah, quite. And...

Wasn't he an RAF meteorological officer?

Absolutely was, and, you know, D-Day was shifted by a day almost exclusively because of guidance and advice that was being provided by a Met Office employee, who shamefully, and I'll need to fix this, I can't from memory pick out the name and I should be able to. Group Captain somebody. And I can't remember his name, but I'm going to do a quick internet and come back to that because it's shameful that I can't state it at the moment.

Christine will know, Christine will know. Now, about future technology, what about quantum computing?

Okay, quantum computing is as much an engineering endeavour and an IT endeavour if you want to see it that way, as it is a mathematical endeavour. And so, you know, in my view the application on machine learning + algorithms... sorry, of quantum in our space and many applied spaces is at least as much dependent upon development of mathematical algorithms as it is on the development of a quantum computer. So we all famously know things like Shor's algorithm, the factoring of large prime numbers or prime numbers, any prime numbers including large ones, directly, they're around cybersecurity because as we all know, that's how we create cybersafe stuff. That's a hotspot for quantum computing because Shor's algorithm is also something that's been mathematically described in quantum. There are other algorithms that are successfully being described. Until such a time when the balance shifts to enough of the mathematics being able to be applied, and there is some great progress, then for us, for me, quantum is interesting but a bit way off down the horizon. That said, there is a specific thing we do is the most, it is the most computationally demanding part of our process which we call assimilation, and this is the act of, if you like, setting the

physical simulation models up with the current state of the atmosphere and then in short term evolution correcting how that model evolves with a known state of the atmosphere. That process is called assimilation and that assimilation process fits mathematically – and we won't go into it, we don't have time – but fits mathematically very very well with quantum computing. So it may well be that in a few years' time, and I'm not going to put a number to it, we're back talking about how we're working with somebody to apply quantum computing to assimilation, as part of the NWP process. In terms of resolving the Navier-Stokes equations, you're solving partial quadratic equations, partial differential equations on some kind of Lagrangian grid, when will that happen? Probably not in my career, but who knows? Never say never.

And anyway, if you do need it, you can turn to someone else and say, that's what we want in our cloud please.

[01:23:26]

Well look, that's a really good point you raise. One thing we recognise really well at the Met Office is our need to partner and collaborate. As we get into this world there is no way we can do this stuff on our own and our science programmes have traditionally been super-good at these. You know, we work under the auspice, in part, of the World Meteorological Organisation, part of the United Nations, United Nation Treaties, alongside 192 other organisations that do much the same work that we do, that's a really, you know, example of collaboration that dates back way back when, well before open data and all that kind of stuff, we were sharing observations around that network. Similarly, our researchers are very, very active nationally and internationally with all the research councils and with other academic people in relevant scientific fields of endeavour, and that's been going on for as long as the Met Office has existed. So we've got some great places to look to how to do it well. We're in the process right now of figuring out how all this big data stuff, the exploitation, production and exploitation of the work that we do computationally, what are the right places to look, who do we need to strike up new and forge new collaborations with. That said, something that we've already got, AWS – I haven't mentioned them yet – we've been working with AWS for over a decade, we're a very

long user of Amazon Web Services, we use their technology in a lot of areas on the kind of front end of our organisation. And we've now signed a strategic partnership with Microsoft. There'll certainly be two of them on that list and we're working with them very closely on what's next for IT.

[01:24:57]

My last question, what is the biggest mistake you've made in your career and what did you learn from it?

Ah, very good. The biggest mistake in my life, going back to the thing, I used to think was doing the thing that I did, having an altercation with the head boy around the laying of a wreath for a memorial service in, can't remember the year, 1987, whatever it was. I used to think it was that, actually. However, with the benefit of a bit of wisdom and hindsight, maybe it was for the best, but that was a big, certainly a big mistake. I think the other big mistake was probably at the point, and I've touched over it, eight years of my career where I knew what I was doing wasn't fulfilling me, but I had this false sense of obligation to be some kind of big fish and earn more money and have a bigger reputation as a CIO and work for a bigger company and all my drivers were [incomp]. I wish I'd had the guts, frankly, to have the conversation that I had with my wife at crisis point that led me to join the Met Office eight years earlier and I had done something else. The thing that was in my head at the time was to go back to university, or go to university, because I could have afforded to do that as well, I wish I'd done that, back in the day. I'll always regret the fact that I haven't, my education has been more formal than I've suggested, probably, but not, I haven't had the opportunity to spend a period of my life doing nothing but study.

You're fifty-seven, what's the future for you? How long are you going to spend at Met Office?

I don't know. There'll come a natural point at which it's time to hand the baton over. That's not yet. That's not yet. Our supercomputer implementation programme is divided into two generations simplistically: generation one and generation two. Generation one, as I've described, we're very familiar with and it's going to be a

supercomputer, we've done it thirteen times before, it's with Microsoft, there are some wrinkles in it and some opportunities and we'll realise those. The generation two, who knows? And that's for me very exciting to think about what it might look like in partnership with others, including Microsoft, and that's going to be a very compelling part of my career which I'm right in right now and will be for the next few years. When that's done and I think that, yeah, that problem's been solved, I think that might be a natural break point, and I certainly wouldn't want to be some, I don't know, dribbling artefact of the past in the corner somewhere not adding any value. So I genuinely don't know. I'll be led by my north star, I'm going to find it really difficult to find something that motivates and drives me as much as the Met Office has done, but never say never. I think that actually helping organisations systems engineer what they do – I worry a lot about science in general, I do, and that's not by any means... I worry that science is at risk of becoming isolated as it sees itself potentially in computational aspects different from the mainstream, different from industry. There's a well-trodden phrase called the Valley of Death, this is the difference between the investments that's made in fundamental and blue sky research versus its exploitation in the industry in the private sector, that's still an issue. I think that, look, let me be very positive about this. The risk is probably assuming that that can be solved from one side of that divide. So my trick at the Met Office is being, to be on the other side of that fence, largely, with a knowledge of industry and technology more widely and scientific comput... try and bridge that gap. And I think that gap needs bridging in a lot more places. So maybe something to do with that. Thirdly, maybe, maybe I will get away and do a PhD, that would be lovely.

I want to thank you a lot, Charlie Ewen, that has been absolutely fascinating contribution and it really does fulfil what we try and do. We have captured the past and I'm sure that will inspire the future as well. Thank you very much, Charlie Ewen.

Thanks for the opportunity, Richard, I really genuinely appreciate it. Thank you.

[01:29:02 end of recording]