



THE UNIVERSITY OF
SYDNEY



Pearcey
FOUNDATION

The Past and Future of Australian Innovations in Information and Communication Technology (ICT)

Oral History Interview

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Peter Vogel

Interviewed by:

Sebastian Boell, Belinda Wang

Interviewed on:

Friday 20 May 2022

Project Summary

This interview is part of a series of oral history interviews undertaken by the Pearcey Foundation and the University of Sydney as part of the project ‘The Past and Future of Australian Innovations in Information and Communication Technology (ICT)’. The series interviewed recipients admitted into the Pearcey Hall of Fame from 2003 to 2020. The hall of fame recognizes outstanding life-time contribution to ICT in Australia in business, research and government. Each oral history captures a short biography of individuals who made an outstanding contribution to ICT in Australia. They also collect insights on aspects that had a lasting effect on ICT innovations in Australia, positive as well as negative from approximately the 1960s to the 2010s. Interviews lasted about 60-90 minutes and were conducted by Sebastian Boell, Graeme Philipson, Peter Thorne, Kai Riemer, Sandra Peter and Belinda Wang. The complete set of interviews in this series is archived by the Pearcey Foundation.

Key Points Covered in this Oral History

1. Funding is critical for the commercialisation of innovation. However, financing through banks for IT technological projects was difficult in the 80s; and venture capitals and private capitals were not supportive of IT innovations back in early 2000.
2. The export market development grants and R&D tax incentives helped the commercialisation and business scale up for both Fairlight CMI and Video Zap. The suggestion for government policy is to make the selection criteria more supportive for early-stage small start-ups when applying for government grants.
3. There were huge barriers to attempted collaborations with universities in terms of IP ownership and funding, whereas the US adopted a very different approach that university resources can deem as a public resource with better accessibilities by industries.
4. The lack of business mindsets or business competent persons might be one of the reasons for the business development barriers.

Biography

Peter Vogel

Co-inventor of Fairlight CMI
Founder of IceTV
Pearcey Hall of Fame in 2014



*Entrepreneur, Innovator, Computer designer,
Lawyer*

At age 60, Peter can be described as a true Australian pioneer in electronics and software who is certainly not afraid of controversy. He obtained his first patent (for a telephone trunk barring device) at the age of 16 and has been named the inventor on many patents issued since then.

By the age of 23, with his school friend Kim Rylie, Peter had developed the world's first commercial sound sampling electronic musical instrument, the Fairlight CMI. During the eighties, the Fairlight was used by many of the world's leading recording superstars including Stevie Wonder, Kate Bush, Herbie Hancock, Peter Gabriel and most of the other big names of that time. New Scientist magazine said Peter is one of "three men who changed the sound of music... Modern music would probably sound very different without Bob Moog, Peter Vogel and David Smith... their ground-breaking work in musical technology led to three inventions that gave pop, rock and classical musicians unprecedented creative freedom." UNESCO says the CMI "transformed the music, post-production and broadcast industries, and helped position them on a course through the next century."

Peter has also designed a wide range of consumer and industrial devices, including "Vitalcall", a personal medical emergency alarm which 20 years later is still the market leader and continues to save many lives.

He has been particularly prolific in the television field. His inventions were directed at making television viewing more enjoyable, for example, by providing an on-screen program guide (EPG). His inventions included an effective device for removing commercials from TV recordings, which decades later brought him into conflict with television broadcasters. In 2003, he founded IceTV, which provided Australia's first subscription based electronic program guide for television, offering a TiVo-like service including the use of mobile phones and web browsers to remotely schedule digital video recorders to record. In 2006 IceTV was sued by the Nine Network who alleged that IceTV's EPG breached their copyright. The case was fought all the way to the High Court of Australia, which in 2009 ruled in IceTV's favour. The decision has been described in legal circles as a significant landmark in Australian copyright law. His expertise in this field saw him give evidence as an expert witness in a patent dispute in the UK high court in 2014.

In 2009, Peter announced that he would be producing a prestigious limited-edition remake of the Fairlight CMI to celebrate the thirtieth anniversary of the first CMIs sold. The CMI-30A

started shipping in 2011 and Peter's company is now developing lower cost keyboard instruments.

As well as developing new musical instruments, Peter Vogel is also:

- Developing new technologies to make independent living safer and more enjoyable for the elderly, as CTO of Vitalcare Pty Ltd.
- Advisor to Living PlanIT, a privately-owned Swiss firm specialising in "Urban Operating Systems" aimed at improving the quality of life in cities through sustainable technologies based on the "internet of things".
- Co-founder of Echidna Energy Pty Ltd, a start-up concentrating on providing renewable energy for Australia's remote and regional communities and industries.
- Freelance journalist and blogger, having written opinion pieces for newspapers and magazines on subjects ranging from hybrid cars to government R&D policy
- Technology Consultant to Mallam Lawyers Pty Ltd, a boutique Technology Media and Telecommunications law practice. (Peter is also studying law at the University of Sydney).
- Developing a new type of baby monitor which makes the baby's heartbeat audible - an invention inspired by the birth of his 5th child in 2013.

As well as his contributions to the arts and technology, Peter has had long standing passion for social and environmental causes. In the 1970s and 1980s he was involved in campaigns which played a significant role in the eventual banning of cigarette advertising in Australia, notably BUGAUP. Peter also helped Rev. Ted Noffs establish "Life Education", which is now Australia's largest, independent health and drug education provider for school children.

Interview Transcript

Date of interview: Friday 20 May 2022

Can you please briefly summarize your biography, where did you grow up, what was your education, and what were some of the names and years of different organizations that you were involved with?

Okay, I grew up in Sydney, I was born and lived in Sydney, and I went to a couple of different primary schools, to two different public schools, and then I got a scholarship in year 7 to Cranbrook Private School, where I did my secondary schooling.

Can you maybe talk a little bit about your school years and how you engaged with technology at that time?

Yeah, well as a child I was obsessed with electronics and later on with computing, and I continued that through my high school time, and the main thing I did during high school was I entered into an annual, it was called I think the 'Schools Science Teachers award', or something like that. Which was an annual competition where students could come up with some sort of a research project and present the project, and then finalists were a group of... about maybe 20 of the most interesting projects got to exhibit their projects at, I think it was generally the Sydney Town Hall. It was some sort of public science fair type of arrangement. And I started doing that when I started high school, and I think I entered that pretty much every year, or maybe from year 8 to the end of high school, and that, when I won that

competition it brought great accolades to the school, whose only sort of contribution to it was that they gave me free reign to do whatever I liked during school time. So, the vast majority of my school time was spent doing my science projects rather than anything else, and because it was such good publicity for the school, I had extreme latitude in my schooling. I could sort of pick and choose what lessons I attended or didn't attend, and the school made a science lab available to me to use as much as I wanted, in or out of school hours.

So you say you won the competition, did you win the competition multiple times, and what for?

I can't remember all of the projects but probably the most memorable one was I built a robot which was designed to learn from, it was an experiment in learning from experience, and this robot was called MERV, which stood for the Mobile Environment Response Vehicle. And the way it worked is it would roam around the floor and it had a number of sensors which could make some very rudimentary measurements of things that it came across. So it had a sort of optical sensor which could detect when there was an object in front of it, and when it came up to an object it would stop in front of the object, and then it had an arm which would come down and touch the object so it could detect whether... it had like an electromagnet on this arm so it could detect whether the object was ferrous or not. And it recorded whether it was a light object or a dark object and whether it was a large object or a small object, and it would then remember this. It would form a very, very simple concept of what this object is, so it might be a large metallic object of a light colour. And on the back of MERV there were two buttons, one called pain and one called pleasure, and you could push one of these buttons and this was the training process. So, if you pushed the pain button it would scream and reverse and run away from the object, and if you pushed the pleasure button it would stay and giggle. So then when it encountered an object similar to this again, it would either run away from it or stay near it. So that was probably my best project, the one that I enjoyed the most. It was also the most challenging because we're talking now about, when would this have been, don't know, I would have been 14, born in '54, so this was 1968, and there were no microprocessors or electronics was very rudimentary then. So the whole thing was built just using transistors and resistors and very elementary sort of logic that made it very difficult to achieve very simple functions that this thing had to do, including synthesising the sounds of laughter and screaming and all that. And I had to build the optical sensor which could detect when it got close to an object and stopped at the right place, which I made by modifying an old camera, and yeah, pretty much everything about it was hand crafted from the ground up. So it was also a very popular project from a news point of view, so I got lots of television spots and newspaper reports and things like that. I can't hear you, are you muted?

I said very impressive, particularly given the time and the ability to program everything in transistor logic.

Yeah.

Yeah, so after, and your ability to perform so well in science projects had a role to play for you getting the scholarship for the private school?

Yes, I would say so.

Yeah, so after school how did your journey continue?

So, after school I wasn't particularly interested in pursuing a university degree, but I was very interested in computers, and the university had a computer, so it seemed like a good idea to

enrol at the university so that I could use the computer. So I enrolled in a science degree so that I could spend all my time messing around with the computer, which in those days was FORTRAN programming using punch paper cards, so to run programs there you had to punch the card deck, hand it into the computing centre. And then sometime, within a day or so, they would run the cards through, and it would get to card number 14 and stop with an error, then you'd take the whole thing away and try again, so there was a lot of incentive to get your program right from the first try.

And which year was that and what university?

It was Sydney University and I guess I would have been 18, so that was 1972.

Yeah.

So yeah, I didn't last very long at that because about, well it was during that year that a school friend of mine, Kim Rylie, contacted me and said he was building this music synthesiser that needed some sort of digital control, would I be interested in helping him with that. So that's when I started on the electronic music stuff, which very quickly took over and I didn't have time for the university studies anymore, so I completed first year and that was as far as I got.

And there was no particular interest from you in music, it was the opportunity to work on something that you loved, and if it had been something else, it would have been something else.

That's right, although it did appeal to me because it was a very practical thing to do and a very concrete ways to use computers. It wasn't just sort of an abstract or theoretical thing, it actually had a very tangible outcome, and you could see the results, I mean hear the results.

So and that was then the start, when you started developing Fairlight.

That's right.

How long did you work on that?

Total of, up until 1989.

So that's close to two decades.

Yep.

Can you trace the journey in these years between '72, '73, and 1989 a little bit for us?

Yeah, so the project at the outset was to control an analog synthesiser using microprocessors, that was the initial idea, and we spent several years, well we spent maybe a couple of years doing that and getting that sort of working. But then we were introduced to a computer engineer named Tony Furse who at that time was working for Motorola, who had just brought out their first microcontroller, the 6800, and he had done a lot of development on a completely digital synthesiser, and I think by that time he had developed a prototype for the Canberra School of Music, and his synthesiser was called the Qasar M8, and it used the 6800s and lots of digital electronics. Kim and I saw immediately that that was a much better approach than the one we'd been pursuing, which was the hybrid digital/analogue synthesiser, so we pretty much scrapped all the work we'd done up till then and picked up what Tony had already developed to a fair degree with the view to commercialising the prototype that he'd developed.

So you said it took a few years until you reached a point of going towards a fully digital synthesizer. In the interim years, did you manage to sell any products or how did you survive?

We did a few other things along the way just to make some money, we had a couple of other products, one of them, 1975 was the year that colour television came to Australia, and when colour television started there was very little colour, there was very little Australian produced colour television programming, it was all in black and white, videotape or film. I thought there was a need for something that can put colour onto the screen other than having colour materials. And I developed a thing called, it was actually the first Fairlight product, it was called the Fairlight Colouriser, and it basically took a black and white picture and had a bunch of controls on the front where you had eight different levels of brightness and for each of those levels of brightness you could choose a colour so that it would make this very sort of colourful, solarised pictures out of black and white things. Very useful for doing graphics and so on, so it was very good for commercials and things that had text and other graphics, but it also was used quite a lot for just pretty effects on music videos and things like that.

So it was not something you would attach to a normal TV?

No, it was for the broadcast industry.

Yeah, but they could use this to retrospectively colorize existing black and white material?

Yeah, I mean the colours only mapped to the brightness levels, so the picture you got was like a posterised version of the original, but it was when people had only seen black and white TV before it was very eye catching. And it was very good for the broadcasters who had spent a lot of money on installing all this colour broadcasting equipment that had very little, when colour TV started there might be one or two hours of colour a day and the rest of the programming was still black and white. So that was pretty useful. yeah, and we just did sort of odd jobs for people who wanted things for particular applications, and anything electronic that would earn us a few dollars. But basically, it was a shoestring operation, and we didn't spend much money, and for the first couple of years it was only Kim and me, so we didn't have any employees to pay.

And how representative do you think was that for the time in Australia, were you very unique in this, two young blokes trying to build electronic devices and selling them, or were there a few other people like you around?

I don't think there were many, it was a very, very new industry at the time. We certainly didn't know of any but then there was also no way of, we would have had no way of knowing if it had been going on elsewhere, because we're talking now 30 years before the internet would happen. So at that time the only way you knew what was going on in the industry is if you heard word of mouth, or if maybe through industry magazines, occasionally, which might give you some insight as to what's going on. But the dream of being able to just turn on a computer and find out what's going on anywhere in the world in a few seconds was still a long way in the future.

So you were largely driven by your own innovation rather than that there were magazines like Electronics Australia that you were following that inspired you?

I still have my *Electronics Australia*... I can't reach it.

Did you publish in Electronics Australia some of your designs?

I did a couple of times actually, I don't remember what, these are more recent ones, these are in the 90s, but my collection does go back. I still have my, prior to *Electronics Australia* it was called Radio, Television, and Hobbies, it was the same magazine before it was rebranded *Electronics Australia*. And that is where I used to wait every month for the next edition of that to come out, and that's where I got probably most of my education in electronics, from that magazine. And I built things, every months had at least one construction project and that's where I would get my ideas for what to build, and that was well before the days where you could buy kits, it was just build everything yourself from the ground up.

But it's not unlike the hobbyist culture that some described that happened in the US where it's tinkering of hobbyists that also drove innovation.

Yeah, I think so. And I did publish a couple of things in that magazine over the years as well.

And was that a good way to get recognition for the kind of stuff that you were doing with the products, such as the colorizer, or was it just almost two independent things?

I don't really know the answer to that, there's no way of knowing, because it's those quaint days where magazines were published and they were sent out and you had no idea whether people were reading them, it wasn't like an online publication where you get feedback and people make comments and ask questions and so on, it's like putting a message in the bottle and throwing it into the ocean, and hoping it gets washed up on some distant shore.

But what I hear it was an important part for you in the space where you're operating that you were looking forward and you get good education from it and you wanted to share back, what was your motivation to send in articles to Electronics Australia? Did they pay you to publish there, to send something in?

I think so, it was probably a nominal payment. I can't remember what my motivation would have been, just I thought what I'd done was really cool and other people might be interested.

Yeah, and then you were introduced by Tony Furse to his Qasar M8 and you immediately took to the idea of developing your idea of a sampler in a very different way, so can you trace a little bit further the journey from there to 1989?

Yeah, so initially we started off just recreating the M8 in a more manufacturable form, The original one that Tony had made was all hand wired, many, many circuit boards full of wire-wrapped connections and was completely impractical to build. And so we made the circuit boards, designed the printed circuit boards, and put everything onto the PCs, and got it into a form that could be sort of reasonably replicated. But it was still pretty limited in terms of what it could do, it was very capable of doing what it was designed to do, but it was still very much a synthesiser, and the sounds that it made were different from anything that had been done before, but it was still very much an electronic sort of an instrument. And I think a turning point came when I heard about the music research being done at Bell Labs in California, and I went to have a look at... there was an announcement that some software had been developed which could accurately model the sound of a trumpet, and I thought well, if it really sounds like a trumpet then this could be something we should be looking into. So I went there and had a demonstration of this thing, and it was one of those computers that fills a whole room and they'd turn it on and it would compute away for a couple of minutes, and then out of the loudspeaker would come 'bap', and that was it. And yeah, it sort of did sound like a trumpet but that's pretty much all it could do, and it was just, they were very excited

and said this is just the beginning of big things, and a few more years and we'll be able to make it sound like some other instruments. Anyhow, so I was sort of underwhelmed by this, but on the way home I thought there's got to be a better way than all this mathematics and complex computations which were... In those days to do the sort of computations needed to model a trumpet sound was extremely ambitious with the computing power that was available then. Then I just sort of got the idea that if you want something to sound like a trumpet, why don't you just take a trumpet sound and reverse engineer it and whack it into memory and play it back. And I mentioned this idea to Kim, and he said yeah, maybe, but how are you going to make it play at a different pitch, and I thought well, we'll just play it back at a different rate from what you sampled it at and see what happens. And within maybe a day of getting this idea I had built the D to A and A to D converters and with my, the good thing was, was the fact that you couldn't buy D to A and A to D convertors at that time didn't really put me off. Then I just sort of made some from the ground up, and then tested it out, and we sampled a sound and played it back at the same pitch, and not surprisingly it sounded pretty much like what the original was, albeit in an 8-bit version, but it definitely...

Do you remember what the first sound was that you sampled?

It was...

I mean it would have been more than just you saying something or no...

I know early on we connected a microphone, and we were just sampling voices and dog bark and that sort of thing, but I think our main sound source was a turntable and we just put on a record and dropped the stylus down at some random point and sampled something, and then when we played it back at different pitches. We were very interested to hear what the effect was when you changed the pitch by a large amount, so if you just played it back a couple of tones away from where you recorded it, it sounded very much like the real instrument, but then it was really interesting to hear what happened if you sampled a bell or something and then played it back two octaves or three octaves lower, and it no longer sounded like a bell, it sounded like some never before heard massive gong or something. And so, we just spent a lot of time sampling all sorts of things and seeing what the effect was when you played it back outside of the normal range of possibility.

Can I ask, how did you find out about the Bell Labs, that they claimed to have this trumpet sound that made you travel all the way to the US?

I think I must have read about that in a magazine, there were magazines, I think it was called something like the *Electronic Music Journal*, or something like that. But that's pretty much how we learned about everything, was sort of specialist magazines at that time. I think, I don't know, I can't remember when it started to happen, but there started to be sort of online databases available, and at some point, this is pre-internet, there were, I don't remember what they were called anymore, but there was a couple of databases. I think one of them might have been called Oracle, and it was a dialup service, so you had a dialup model and you paid quite a lot of money to subscribe to it, and then you could dial into it, it was a completely text-based interface, and you would put in a search term, so say you want to search for electronic music or something and then it would pull up journal articles, or news items that matched those key words, and you'd download them all, it was all text, there was no images or anything, it was just a text-based database. I'm trying to remember what it was, what this early...

There were services called LexisNexis, I think that's more legal but one of the big operators was...

It was long before those... it was long before LexisNexis, it was... then CompuServe was one along the line...

Yeah, that would have been at the 80s, yes.

Yeah, so I had subscriptions.

That was some of the first online experiences for you were sent to go onto one of those databases...

About 300 bits per second, yeah.

So how long did it take then to get an article?

Well, they were only text, so there were no images, so it was only, an article might have been 100 KB or something, so you could download that in a few minutes. But it was pretty exciting.

And the dialup was within Sydney rather than overseas, I assume?

Yes, yeah, that's right. And initially the modems used acoustic couplers, I remember you'd put the telephone handset into the modem physically, the modem would have a place where the handset of the phone sat in, and you could hear the audio going as it was chatting.

But you didn't build any modems yourself?

I did later on, the first ones were these acoustically coupled modems, then the high-speed modems where we went up to 1200 bits per second, those ones I built myself, and we'd bypass the telephone handset.

So was that like something that would have appeared in Electronics Australia, a schematic for a modem and then you would just build it like that or you designed it from scratch?

I don't remember anymore, probably both.

Yeah, so you said like you went to the Bell Labs and this is when you made the switch from synthesiser to sampler, when you realised, and you went out and sampled lots and lots of different things, how does this get you to the finished product that you became famous for around the world in music studios?

Yeah, so once we heard that the concept was good and that you could actually get very usable sounds, even using 8-bit, at that time it was only 8-bit computing and 8-bit sounds, so they were very dirty compared to the original, but still very musically pleasing, it was immediately obvious that this was the big breakthrough and this was the way to go. And that compared to all the other synthesis techniques this was much, by far the most important, and it was the one that was just, musicians who saw it just thought that it was magic, because it had never been possible to play on a keyboard and make it sound like a trumpet or make it sound like bells or voices or anything else, it was always some variation of an organ or a synthetic sound up till then. So, it was pretty easy to convince musicians that they wanted it, the difficulty was the price.

How much was the initial Fairlight, if you break it down into comparable things that people had, compared to a motorbike or something like that? Was it a similar price tag?

No, it was much more, when we started they were selling for about \$50,000, so at that time our factory was in Rushcutters Bay and I wanted to find somewhere to live close to there, and the nearest sort of residential street to where the office was, was in Paddington, and I bought a terrace house in Paddington for \$80,000, so that gives you an idea. Lots of our customers, since then and recently, have said that when they bought the Fairlight it was a choice between do I buy a house or do I buy the Fairlight, and several of them have famously said that if they'd bought the house they would never have a Fairlight, but because they bought the Fairlight they've now got several houses. So, it turned out well for them.

Do you want to mention some of the most famous people that you sold to or pieces that were created?

I was never really across the customer base, like I wasn't on the marketing side or anything, I was just the geek who was behind the technology, and I never knew who any of these people were.

So how did you finance that, when you said the Fairlight was more than half the cost of half a house in inner city, Sydney, I mean you needed to have the parts to build the Fairlight before you could sell it, how did you achieve that and at the time, how was the access to finance?

It was dreadful, it was a nightmare, we used a lot of credit cards, Kim and I had several credit cards each, our families lent us money, not huge amounts, like we maybe borrowed \$10,000 from family. I think we asked for deposits on sales, so we got some money upfront, but it was a constant struggle, and as you rightly say the components were extremely expensive. So we're talking about, in these days, we had one of the first devices that use floppy discs, when we started out with the very first system we developed, we actually used paper tape to load the program, and it was only a year or so into it that we added a floppy disc system to it, and in those days the floppy disc drives cost about \$1000 each. So even those components were ridiculously expensive, and that was probably our biggest problem all along, was lack of finance, and that's ultimately what was our demise as well, because it was simply never profitable, and never properly financed.

And so did you, I assume most of your components came from the US at the time?

Yeah.

They were not manufactured in Australia, did you ever play with the thought of relocating to the US to be closer to the music studios, to be having possibly less, reduce your production costs by having less shipping and so on, was that something that you contemplated, and what was the reason why you decided to stay in Australia?

We did, at one point we opened offices in the US, we had an office in California, and another one in New York, and it turned out to be a disaster in that it cost, it was just unbelievably expensive, everything. The advantage of doing it in Australia was that everything was cheap and could be done on a shoestring, and there was a lot more, what would you call it, more willingness to use sticky tape and string for things, whereas anything done in America was always large scale and expensive, and I just recall doing anything in the States was extremely expensive, so fitting out an office or having a product launch or something like that, it was always hundreds of thousands of dollars to do anything, possibly because start-ups they were well funded, so when someone was trying to do what we were doing they'd raise, they'd get a

10 million first-round funding that they could do those sorts of things with, and we'd never had that privilege.

And there was no opportunity to say, like to go to the US and raise capital there because nowadays that would be not a problem to raise capital overseas?

Yeah, it was much harder in the 80s, the whole venture capital thing was still very new, and it would have been difficult to do, and we had no idea how to go about that.

So in hindsight, would you think if you had some expertise, could you have raised venture capital or was there just nobody understood, the banks wouldn't understand and investors wouldn't understand...?

Yeah, well we did try and get a loan from the bank, and we did a presentation to the lending manager of what we were doing, and I remember to this day his blank expression, as we tried to explain what we were doing. He had no comprehension whatsoever, but at the end of the presentation he said: look, I don't know about this music thing, I don't know about these electric organs, but I do know there's money in computers, so we got a loan. I think it was \$5000 at the time was our loan, which we thought was going to be enough to get this product off the ground. And unfortunately, it was one of those loans where the directors signed that they would personally guarantee the money borrowed by the company, initially, and from time to time as to whatever the amount might grow to, which Kim and I promptly forgot we'd signed, and which was still in place in 1989 when the company went broke. And so, by that time the borrowings had grown to like \$2 million or something, and so when Fairlight was wound up, the banks came after Kim and me on the strengths of these guarantees that we'd signed 15 years earlier, so that was a very unhappy ending to that story.

So you would say that in that regard it really then hindered your ability to put yourself back up together and start something new?

Well, it was still really difficult, even in the 90s, like one of the reasons that we went broke was the financial situation at the end of the 80s, there was some big, I can't remember what it was, but I remember interest rates being like 14 percent at that time, and it was just impossible to borrow money under any circumstances at that time.

And as you said, there was no understanding of technology and there was no venture capital available, whatsoever?

Yeah, pretty much.

So what I'm referring to is like it's said innovators, what Australia is not so good at is people do something and then they are failing but they learn important things and then they can use it for the next venture, instead of somebody described it as we have the glee club, we like to celebrate success instead of looking and examining failures and learn through that. So having these huge debts hanging over your head from the bank, I imagine couldn't have helped in taking the next step and trying some other product, which you nonetheless did.

Yeah, well it's quite true, I thought I had learnt from my mistakes and I took some time to actually think what were all the things that were right about Fairlight and what were the things that were wrong. And I vowed that the next product that I made was not going to be something that only a dozen people in the world could afford, so it had to be something affordable and it had to be something that the average person could understand and want. So I

was thinking the opposite of everything about Fairlight had made it difficult and uneconomic, and had been a struggle all along, so I thought my next project is going to be something that everybody wants and can afford. So that's, I'm not the first person to have come up with that idea.

So what was then the next product that you found fit these criteria?

So at this time we were talking about the dawn of the VCR era, so this is when VHS recorders first became popular, and for the first time people could record TV programs so that they were liberated from watching TV when it went to air. You could theoretically program your VCR so that the program that you wanted would be captured and you could watch it at a convenient time, that was the promise. Now, the big problem was that nobody could figure out how to make the VCR actually record the program that you wanted to record, and it was just sort of the running joke that you would come and play back your tape and you'd discover you'd recorded the wrong channel, or it had started at the wrong time and you'd recorded the wrong program. Or typically the program would run ten minutes overtime and you'd miss the whodunnit, the tape would run out before you go to the bit you wanted. So it was a technology which sort of had promise but was immensely frustrating. You also had to make sure...

It had a much bigger market and people understood.

Yeah, so VCRs were hugely popular and everyone had them but they ended up just using them for playing rented videos, so that was the time that the Video Ezy and Blockbuster Video and things like that were very popular and every suburb had rental stores where you could go and rent a tape, and that was good. But the capability of the VCR to actually record programs off air was rarely used, because it was so inconvenient. And so everyone I could ask I said: if there was a problem that could be solved by technology what would it be, and the answer that I got repeatedly was: to be able to record program on my VCR successfully. And the other thing that annoyed people immensely was the amount of advertising on television, and not only was there a lot of advertising but the ads were increasingly made to be more and more annoying. So ads, there was a competition going at that time to make ads as loud and obtrusive as possible, so you'd be in the middle of a nice quiet scene in a program you're watching and then suddenly you go to a commercial break and it's all screaming and people shouting in your face and very loud and so on.

And is this what you then used...?

Yeah, so I thought...

The noise level, is that what helped you to detect the ads?

No, so I identified what the problems were that needed to be solved, one was recording programs easily and getting rid of the ads, so if I could solve those two problems then I would have something that everybody wanted to buy. So, I started off by looking at what had been done to remove ads previously, and there was a huge number of patents in the area, dating back to radio. So pre-TV there were already inventors turning their minds to how do we mute commercials on radio, and they were quite interesting actually. The one that's most often attempted is to look for the sudden jump in volume but that of course is very, very unreliable because you get people in the middle of a program start shouting at each other and it decides it's a commercial and you lose the best bit. So that idea is no good. But one of the more interesting ones to do with radio was simply a system which detected the difference

between music and speech, so while there was music playing it considered that you're listening to the radio, and as soon as you hear speech then it must be a commercial. That was in the days when radio was basically music being played interspersed with advertisements which were just usually spoken promotions: buy this new Sard Wonder Soap, keep you clean sort of, as soon as there's voice that's a commercial. So, I spent a lot of time looking at what's been done before and why it had failed, and I quickly concluded that any sort of technology that you develop that relied on the content of the program was doomed to fail, because no matter what it is that you rely upon to detect a commercial the broadcasters can change that and screw it up. So I even looked at systems which actually you trained by showing it commercials and saying this is a commercial, next time you see it, mute it, and that was a pretty good idea but first of all it was quite complex technology to do that, and expensive, particularly because we're talking the 1990s. Maybe not so hard to do these days, and the other, it's still not foolproof because you can imagine a movie or something where, as part of the movie. there's a commercial playing on TV. People are watching TV and a commercial comes on and you don't want it to block that out, so it needs to be smarter than that. So, I ended up with a couple of different methods, probably the one I was most pleased with was a system which relied on the fact that television programming is syndicated across different cities, so if you watch television in Sydney, you'll have much the same programming up and down the east coast, so what's on TV in Wollongong or Newcastle or Byron Bay is going to be the same. The only thing that's different is the commercials, they have local advertising. So, my first stab at this was receiving the same TV channel from several locations, and comparing the programming, so where it's identical you know that it's a TV program, and where it varies you know that suddenly you've got a local, the local KFC is advertising in Wollongong, and so it's a commercial. Now that gives you about probably 80, 90 percent of the answers. And then I had to deal with the question of well, what do you do with the situations where you've got either maybe just by coincidence, if they happen to run the same ad in two places and had to deal with that. And I eventually came to the conclusion that there is no substitute for human intervention, so all these things, like I could see, I had a whole battery of TVs in front of me and I'd be watching Newcastle here, and Sydney here, Wollongong there, and I could see what was going on, and I had no trouble at all, saying that's a commercial, that's a commercial, that's not a commercial, it's easy. So, I figured, why not take the easy way and we'll just employ people. You only need like one or two people to sit there and watch TV 24/7 and push a button when a commercial comes on and then push another button when the commercial is finished, and then that's broadcast to all your subscribers. So that's what we did, and we had a control room in Sydney where we had people rostered on 24/7 watching a whole lot of TVs, and when a commercial comes on, and you often get warning because you can see that a commercial break is going up, it doesn't happen out of the blue in the middle of a program, you can see the programs fading to black and it's getting ready for a commercial break, so the operator gets very good at picking the commercials, and also they...

How was that signal then transmitted to your device, and how did this interact with the VCR?

Yeah, so they're the next problems, so we're in a pre-internet era, okay, so we can't just send it out over the internet. So the prevailing technology for sort of broadcast messaging in those days was paging, so we had these, which are still used to a fair degree today, the pocket pagers, which were ideally suited for this because they're designed for very, very short messages, so they're the sort of things that doctors still use, so if the hospital wants to page a doctor who has wandered off across the road to some distant part of the hospital or something it sends a message to them. So we had a transmitter at the top of Centrepoint Tower which

would send out a message which just had very limited data, it just had the channel number and whether it was a commercial or a non-commercial starting. So just every couple of minutes there'd be a blip of a message and that would be picked up in these set-top boxes. So, then the next question you raise is how does this then interact with your VCR? So the way it worked was that when this message is picked up saying "commercial on channel 7", the set-top box had an infrared transmitter in it and this infrared transmitter was trained to behave like your remote control, so it would send out a pause signal to the VCR when the commercial starts if the VCR is recording the channel that that event happened on. So if you're recording a program on channel 7 and you get a message saying commercial on channel 7 it would send out a pause, the VCR would pause and then at the end of the commercial break it would start up again, and this went really, really well. And then the next step from there was I thought, well if you're sending out these messages saying that it's a commercial or it's not a commercial, why don't we send out some more details as well, and we can classify the program content to a finer degree, so we can say this is a children's program or not a children's program or whatever, or adult content or not adult content. So you could then create a system which could then provide parental control functionality as well as the commercial zapping, because in my mind there was no difference between whether you're zapping commercials or zapping anything else that you choose to zap, and you've got the people sitting there watching the programming so you might as well make use of them. So the system evolved further, and then the next step was the programming guide, so that you could record programs simply by picking them off a list, rather than programming your VCR by time and channel, so the next step was to build an electronic program guide into this system where you'd get an onscreen guide and just pick the program that you want: Say yeah, I want to record that one. And then when that program, this overcame another problem is that TV programming, particularly in those days, was very fluid, they didn't stick to schedules particularly, so these days, because it's sort of all done electronically and in an automated way, it's pretty reliable that if a program is scheduled to start at 6:30 it will actually start within a few seconds of 6:30, but in those days it could be up to five minutes late or early, just depending on what was happening, and whether the person at the studio was slow picking up the tape and putting it on the machine or someone has fallen asleep...

Or breaking news or whatever.

Yeah, breaking news, all that. So, I enhanced the system then to actually identify what program was starting on any channel, when the program actually started, so we'd send out a signal saying that this program is now starting on this channel, and then if you've decided you want to record that program then the infrared device on the set-top box would send out a start-recording signal. So, it no longer required the VCR to have the clock set to the right time, so typically people who bought VCRs the clock would never get set because it was too difficult to set, so most people's homes just had a VCR with the zero flashing on the clock all the time, because they'd never figured out how to set the clock. So, it was a really...

Or at least once a year when you change summer to wintertime... daylight savings.

That as well, or a power failure. So, it was a very good system and it worked really well.

So what was the name of the system, and you said it was subscription based, so people would they buy the device and then a subscription or did you get a subscription and the device comes with it?

Both options, so there was a pay a higher amount up front and a lesser subscription or pay a higher subscription. So initially it was called Video Zap. I thought that I would have no trouble raising capital, because this is something that needed to be done on a big scale, this wasn't going to be onesies, twosies, this would have to be a consumer product and to build thousands and thousands of them to make it economical. I thought that okay, I've now got a product that everyone wants and everyone can afford. I will have no trouble raising capital for this, and it was a fantastic demonstration, because I'd take one TV and VCR and the set-top box and I'd put it on the board table at the VCs and I'd say okay, watch this, and I'd bring up the EPG on the screen and I'd say you want to record this program starting at 2 o'clock? There, that's all you have to do. Wow, and then 2 o'clock comes around and the VCR would suddenly spring to life, and it would start recording, and they'd say that's very cool. Then I'd say: now watch this, and the commercial break would come up and as soon as the commercials start the pause light flashes on the VCR and it's in pause. Then you play back the tape at the end, and you've got a program with no ads in it, and jaws dropped and everyone was very excited. And invariably what would happen is that at these meetings they'd all say "Wow, I would want one of these, everyone I know would want one of these, works really well, you're a genius, we're all going to get rich, no problem, how much money do you need, we'll get back to you." Then days would pass and there would be silence and then I would follow them up and say well what's happened with our term sheet? And they would all have the same story, they'd say: Well, we've given it some thought and we just think it's too risky. I said: where's the risk? and they said: someone's going to stop this, they won't let this happen, and...

Too good.

They all got cold feet, and then one of them said to me: Look, we think it's great and you think it's great but we really need to see some market research to prove, people always say oh yeah, I'd buy that if it was available but then when it comes to forking out money it's a different story, so we need some independent market research to see what people would pay for this. So I hired a market research company to do a telephone survey and the interview went something like if you could have a device which removed commercials from your recordings, would you like a device that removed commercials from your recordings. And everyone, 100 percent say yes, would love that, and then they'd say well would you pay \$1 a week to have it? And then they'd escalate the price, they'd say would you pay \$5? Would you pay \$10. Then they'd get an idea of where the price point was. So they did this survey and when I was due to get the results the results didn't arrive and I rang them up and said what's happened to the results? And they said: Oh, it's taking us a little longer than we thought it would, we've just had to send it back, the final approval from our boss. He said: Go back and check it, because the numbers that they'd got had made no sense. The guy I spoke to said: Look, we did a market research for a digital camera and we're asking people if you could buy a camera that didn't need film would you buy it? And we were getting answers like 6 percent, 8 percent of people were saying: yeah, I'd buy that, and they're the sort of numbers we're used to. And when we ran this it was like 80 percent, it was like 100 percent of people said yes, I want it, and then 80 percent of people said yes, I'd pay \$1 a week and 70 percent said I'd pay \$5 a week, and 50 percent said I'd pay \$10 a week and it made no sense, and so we've got to go back and check it, but that's what they found. And then I went back to the VCs with this outstanding market research, and they said: We don't believe it, I don't

know, it's too risky, we're all going to get sued, Rupert Murdoch will send out his hitmen, we'll spend the rest of our lives in court, surely it's illegal. I said: What do you mean illegal? And they said there must be some law against it because it just seems wrong that you can do this legally. I said: Well of course you can do it legally, what law do you think we might be breaching? So, they said: we'd really like to see legal advice. So, I go off and see a technology lawyer. Gilbert & Tobin was the firm, and they looked at it and they looked at the *Broadcasting Act* and the *Copyright Act* and all those sorts of things, and said: No, we can't see any problem with it, it's all fine. Then I went back to the VCs and said: Look, the legal people say it's all fine. Then of course they said: I don't know, lawyers often get it wrong, I don't know about this, we've just got a bad feeling. Or: One of our main fund members also runs an advertising agency and when he heard about it, he said he was going to pull his funds out if we do this, and it'll be the end of...

So at the time VC capital was available but I hear it was hard to access, still.

Indeed.

But eventually you managed to raise some capital, I mean you describe a product that was working in Sydney, right?

Yeah, well we ended up getting some private capital, but it was not nearly enough. I can't remember, it was something like we were after \$5 million and we got half a million, something like that. And so I thought, we'll see what we can do, and the answer was that you can't do much with half a million, so we then decided that we would use what little capital we had available to do an IPO. Because I foolishly thought that, although the VC industry won't get behind this, the public will, because it's something that everybody wants, and everybody will be able to see that it's got legs. So, we spent our last couple of hundred thousand dollars putting together this IPO, and we actually got to the point of opening up to take subscriptions and the money started coming in. And we did about a week, we got a letter from the 9 Network saying you're infringing our copyright and we're going to sue you. So of course that then brought the IPO to a halt because it then had this legal shadow cast over the whole business. And that then started a process over several years where we were in court with Channel 9 over the alleged infringement of their copyright in their broadcast schedule. Their argument being that, their claim was that the list of programs in the order that they go to air and the times that they go to air was a literary work which was protected by copyright. And obviously for any work to be copyright you have to be able to identify an author, and you have to be able to argue that it's a literary work and they tried to do both those things and it was thrown out by the first judge, and then it went to appeal and the appeal court overturned the original decision and was in favour of 9, and then we took it to the High Court and it was overturned again back in our favour. By that time, it was too late, the business had been scuttled.

Do you think in hindsight, had you been able to raise the \$5 million it would have turned out as a very different story?

Yeah, I think so.

So again, lack of funds was a problem.

Yeah, I mean we could have done that, the thing that's very common these days is to run the business at a loss until you've got a large customer base and you're sort of established in the

market and then it suddenly becomes valuable. I mean these days things are valuable right from the outset, even while they're in that building customers and losing a fortune stage.

But I guess that still would have required a certain amount of capital investment on your side for setting up all this, building the set-top boxes or building these boxes, sending them out, and then you have to have people watching the program, I mean you have ongoing costs, I guess that's what I'm saying.

Yeah, well that's why we thought, that's where we got the \$5 million budget from, and it was pretty, because it was a recurrent revenue sort of business there was income from day one, and the subscribers, I can't remember how many subscribers we had, maybe, no, no idea, it wasn't a large number, it was maybe 1000 subscribers, but...

And it was here in Sydney?

Yes, I can't remember whether it was anything, whether we extended outside of Sydney. Because what happened then, was that around that time the internet was taking off and so there was then a whole new market opened up because there were lots of software products that would record television on a PC. And so Microsoft brought out something called, what was it, I don't remember what it was called, it was a TV recording type of application which ended up being very popular.

So after that, I'm sure that held you up a few years in the courts, was there another product that you built after that or did you decide that's it, I'm done with trying to be an entrepreneur?

Now let me think, what was the order that things happened? Then we came around to the 30th anniversary of Fairlight and I was pretty regularly by that stage getting emails from people all over the world who owned Fairlight. I estimated there was about 200 of them still in use by then, so this was 2009. And I started asking them why do you still have a Fairlight and why do you still use it when it's been so thoroughly obsoleted by much better and cheaper other products that can do much more? And I discovered that there was still a big yearning for that sort of an instrument, which it had a sensuality about it. It was sort of big and heavy and a glowing green screen and a laptop running some software wasn't the same thing at all. And quite a few people said how sad they were that their Fairlight floppy discs had worn out and you can't buy floppy discs anymore, and things like that, so it was becoming a maintenance problem.

Was it 8-inch floppies or did you upgrade over time?

No, we never upgraded, when we went out of business in '89, it was still 8-inch floppies were the state of the art. I'll show you one.

Did you try to read some of these discs?

This is the Fairlight library.

Oh, have you digitized those?

Yes, they've all been digitised, not by me but other people have done it along the way. Yeah, so that's what an 8-inch floppy looks like.

I'm leading the efforts of cataloguing for the ACMS, so we have a lot of 8-inch floppies. We have one volunteer that has recreated or built an 8-inch floppy drive so he can read these old discs, that's why I asked, have you been digitizing...?

I see. Yeah, there's also people now who've made adaptors that will drop into the Fairlight, which replaces the floppy drive with a little SD card. It's a big box with an SD card inside it and an interface, it makes it look like an 8-inch floppy to the system. There's a lot of these enthusiasts. So anyhow, I decided that what the world needed was a CMI which looked and worked like the original but using modern technology that could be maintained if something went wrong with it, and less expensive than the original. And there was a lot of enthusiasm for this idea and so my idea was that I was going to build a limited edition 30th anniversary reissue of the CMI, so that's how the CMI-30A was born, and my plan was to make just 100 of these, and it was I think \$25,000 was the price tag. And this was at the time when it was very popular for people to make reissues of guitars and things like that, so there was a lot of guitar companies who were bringing out limited edition famous type of guitars that famous people had used, and they were pre-selling their whole production run at \$20,000 or \$30,000 for a guitar, so I thought this would be a good idea.

So anyhow, it seemed like a good idea at the time, and the main obstacle was that the Fairlight trademark had been bought when the company went into liquidation in 1989. The trademark had been bought by another company who was basically a family owned company in Melbourne, who at that time owned the Fairlight trademark. And I entered into a licence agreement with what was then called, the company was then called Fairlight.au and it was to use the trademark for this CMI-30A, because Fairlight.au was at that time no longer doing electronic musical instruments at all. And I had only just started shipping the first, I'd built the first production run of the CMI-30A and the guy who owned the company had a stroke and his son took over the business and his son decided that he didn't want me using the trademark, I don't know, I never found out why, but he just told his lawyers: stop that Vogel using our trademark, and the lawyer said: Well, he's actually got a licence to use it. And he said: I don't care, stop him. And this is a guy who is used to the idea that if you throw enough money at any problem it can be solved simply by outspending. So I got a summons, saying that I was in breach of their trademark and they started proceedings against me in the Federal Court in Melbourne, and no doubt their thought was I would go and see a lawyer and the lawyer would say: Yes, we'll represent you and we want \$50,000 up front and that would be the end of the matter. However, that was not the end of the matter by any means, and I got my \$39 flight to Avalon Airport and fronted up at the Federal Court and told the judge that this is a dispute between two Sydney-based companies and it should be heard in Sydney. And the judge very wisely got rid of the case and transferred it back to Sydney. So from then on it was much easier for me to manage it and they were flying lawyers up from Melbourne, and this then turned into I think, about a seven-year dispute. And just at every time they turned the heat up a little bit to try and wear me down I made it more difficult for them. And at some point along that process, after it had been going for a couple of years, my wife said to me: Oh God, is this case still going, how long do you think it's going to go for? And I said to her: it's going to go for a long time, in fact I bet you I could get qualified as a lawyer before this case is out. And she said: That's not a bad idea. And so I thought: Well, I'm doing a lot of law, I might as well get some benefit out of this. So I enrolled at Sydney University as an external student and did part-time law, did the degree remotely, part time, and as it transpired I got my qualifications six weeks before the final hearing of that case.

And in the final hearing were you then representing yourself still, I guess?

Well, then I wasn't representing myself, my legal persona was representing my company by then. And it was, again, a successful outcome in that I won the case. But by that time, of course, the whole business was well and truly dead. And the damages award was only a fraction of what it was really worth, in that I was claiming damages for the loss of the income that could have been if he hadn't stood in the way, and the damages that were awarded were only about half of what I'd actually spent on the development. So it was a victory but a rather unsatisfactory one, but the benefit was that I came out of it with a law qualification.

Wow, and now you're working on the CMI-40B?

Now I'm not working on anything electronic. Well, that's not quite true. So, another part of my story was that in 1982 I was asked to design a personal alarm system. I met a doctor who had a lot of elderly patients who'd sort of had falls and not been able to get to the phone. And I came up with this product (which at that time was called Vitalcall), and it was a button that the person wears around their neck and when they press the button it would start a little cassette tape playing a cassette and dialled a series of phone numbers and play a message to whoever answered the phone.

It's a remote control for an answering machine that calls and plays back a tape?

Yeah, that was pretty much it, and I designed that system then and I designed the computer system which sat at the call centre. When people pressed the button and it would bring up on a screen who was calling and where they lived and that sort of thing so that people could send an ambulance. I then had nothing to do with that product or that business for many years, until 2014, when I bumped into a person who had bought, that business had split into two parts. It had split into the personal alarm business and into the nurse call business, which was providing similar technologies for use in aged care facilities and hospitals, and that part of the business is called Vitalcare. So there's Vitalcall that I had nothing to do with and who are still providing the personal alarm services under that brand, and Vitalcare. And the guy who owned Vitalcare didn't know what to do with the business, it hadn't really progressed much over the last 20 years, and he wanted out. So I and one of the other ex-Fairlight, Duncan Ross, who had been my partner in the CMI-30A business took over Vitalcare. So I got back into the aged-care business in 2014. And I sort of looked at where the technology had gone, which wasn't very far since 1982, it was still pretty much the same concept, and decided there was a lot of opportunity to utilise new sort of technologies to vastly improve the way that sort of care is delivered. So that's what I did for the next few years up until becoming a lawyer in 2019, so from 2014 to 2019 I was the CTO of Vitalcare, and I'm still a major shareholder and technology advisor at Vitalcare, but spending most of my time being a lawyer now.

Yeah, so hearing the amount of legal troubles that you were involved in and also financial troubles, if you were in charge of making laws in Australia, what would you change to make it easier to support innovations in technology?

I don't know that there's any legal framework that's the problem, it's more just the government's ambition or lack of ambition to foster technology. I mean along the line, like over the years the support for innovation seems to have diminished rather than increased. We took a lot of advantage of the export market development grant, that was good for us, and the R&D incentives have been pretty good.

So that was with Fairlight CMI or was that with Video Zap?

With both, yeah. The export market development grants have always been quite good, and the R&D tax offsets and so on have been quite a good stimulus, but I think both of them have been wound back and restricted, and they're making it more difficult and less funds available and so on, and it's pretty small amounts of funding available for innovation through government sources.

So you would say one thing that could be looked at is to make more government funding available for innovative companies and start-ups?

Yes, and more, and I guess to change the criteria as well, make it easier for really innovative ideas to get funded without having to, there always seems to have been almost a need to prove that you don't need the money or they won't give it to you. So you can only get a grant if you can prove that you don't need it, it's always like given out in terms of matching grants or you've got to prove that there is a market and show that there's a customer, so you can get funding for things where you've got a proven market and you can sort of show that...

So am I hearing correctly, you're saying the burden to apply and get this funding is too high for a small start-up, if you are two people that have just come up with the idea of we want to build this new device, you don't have the expertise and the resources to come up with matching grants and to do the market research so that it's too difficult to access this kind of funding, too much bureaucracy?

Yeah, that's part of it, but it's also I guess the stage that they will fund, they will fund, once you've got a proven product and you've got a proven market then I guess it's still this risk aversion thing in that there's no funding for early stage, when it's just an idea, you're not sure that it's going to work and you're not sure that there's going to be a market. I guess that ties in with, my other comment would be that the way that universities work with industry or don't work with industry has always been terribly problematic. And I don't know if it's any better these days but whenever, on the occasions where I've tried to get some sort of collaboration going with university engineering or the science departments there's always been huge barriers put in the way in terms of the IP ownership or the funding or God knows what. Seems to be very different to the approach taken in the US where it seems to be like universities in the US are a public resource where stuff is developed and can be used by industry much more easily, or people spin off these businesses from universities all the time that become very successful enterprises. There seems to be a very different attitude in Australia to commercialisation of university technologies.

So I think what you're saying is something that we have heard a number of times that there's risk aversion, and you said there should be more openness to just fund an idea and see where it goes, rather than say like we only want to fund fully commercialisable products, which now that we have a much better VC environment would get the funding through that anyway, I would argue, or at least it would be much better than it used to be, and the collaboration with universities, another one where are like people the intellectual property handling at university has become really worse over the last decades.

Yeah, I haven't been across that in the last few years, so maybe it's changed, but certainly ten years ago when I looked into using university or commercialising university-sourced research it was just made impossibly difficult and uncommercial to do that.

Possibly it's gotten worse because universities have less government funding, that means they have to try to pursue this extra income streams even more, so unfortunately, I'm not sure it has improved over the last ten years.

Yeah, I certainly haven't heard of any improvement.

Now, I see we are going towards the end, overtime already for the interview, so I don't want to take you too long. There's two questions I want to wrap up with and one is, is there anything particular to the Australian psyche or situation that supports innovation in Australia in IT or that you found is notable about the Australian environment? And if there's nothing, that's fine. And the other question that we have is what are particular disappointments during your professional career with the IT industry in Australia? We always end on a high note.

Yeah, difficult questions. Well, I think they're two sides of the same coin. Because the landscape is so bleak people are more inclined to sort of give things a go and to underestimate how hard it's going to be, and so they'll just have a crack at something that maybe with the benefit of more experience or thinking about it more carefully they wouldn't even contemplate, so maybe that's a...

Could I then maybe follow up very briefly to go back to Fairlight, so you said that access to capital was the biggest problem. Other than that, in hindsight, what really could have helped you if you had said like had we known in '73 what we know in 1989 we would have done certain things differently and that would have made a difference?

No, it was mainly that, it was mainly just the lack of capital that was the...

Would you have involved somebody with a business mindset or do you think you had enough business skills within the team?

We had no business skills but that's probably how we got as far as we did, in that if we'd had someone with a business mindset, we would never have done it.

Okay, fair enough.

We wouldn't have funded the company using credit cards if someone sensible had been in charge.

Thank you so much for the time, for the interview today.

End