Oral History of Rich Page, part 2

Interviewed by:
Hansen Hsu

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Hsu: So it is November 27th, 2018. I am-- oh, it's 29?

Page: 29.

Hsu: All right, 29th?

Page: <laughs>

Hsu: 29th, okay, 2018. I am Hansen Hsu, back with Rich Page, and you mentioned you had a funny story.

Page: So, I mean, the factory was quite automated. There was a lot of equipment that NeXT purchased, and, you know, built a big in-line surface mount line, and with, I don't know, 8 or 10 pieces of equipment, and the biggest ones were the, like, the reflow oven. So you get all the parts placed on it, soldered and everything, and you got to reflow the solder, and so I remember when it was getting put together the small company that delivered the reflow oven, you know, obviously just an agent for the manufacturer, you know, he brings the reflow oven in and starts setting it up, and the large panels on the side were just kind of hung on the equipment, right, for decoration, but the gray color that was the panels wasn't the right gray.

<laughter>

Page: And I remember we told him, like, "Well, you got the paint samples from us. This isn't really the right color," and the guy says something like, "Well, it's close. It's not like the CEO's going to care."

<laughter>

Page: Wrong. <laughs> So we told him, "Ah, I think you don't want to leave them on there. I think you want to take them off and go get them repainted and come back."

Hsu: <laughter>

Page: But his comment is like, "Well, it's not like the CEO's going to care, right?" Oops. <laughs>

Hsu: Well, out of any CEO that would care...

Page: It would be him, yeah, and on a related note, there was a point early on where Steve [Jobs] wanted the factory to have a van to run errands and take things around and stuff, and he imagined something that looked a little bit like one of our white boxes, and the boxes were this bright white with the NeXT logo on them, and so somebody in materials bought this Ford van, only that year they didn't have a bright white. They had sort of this cream color white, and Steve happened to see the van right after they

purchased it, and he comes in and he says, “Who do I fire?” <laughs> Because he was upset. Like, “It’s really simple. It’s supposed to be white. This is not white.”

<laughter>

Page: So we took it out and got it repainted.

<laughter>

Hsu: So the surface mount technology, how new was that at the time?

Page: It was relatively new. In the-- I think, you know, back in 1980, ’81, ’82, everything was through-hole, and in the ‘80s it was making the transition, and I don’t know when the world kind of moved completely to surface mount. It took quite a while, but it was probably 1990 or later before most things were surface mount, and so while were in the middle of that transition, and so there were certainly other people that were ahead of NeXT but, you know, but NeXT was pretty early in the game, yeah.

Hsu: And that was one of the important technologies that allowed the factory to be automated?

Page: Yeah. It made the product a bit smaller, denser. You know, it may have improved yields to some degree, because surface mount parts are, you know, once you get it working, a little bit easier to place, because you don’t have bent leads and things.

Hsu: Right.

Page: So probably harder in the beginning but quickly becomes easier, I think. Yeah. Mm, so surface mount was clearly the way to go. Just it was still pretty new, yeah.

Hsu: Why was it so important to Steve to have the automated factory?

Page: I guess just the improved quality and with some volume the reduced cost. But one thing happens with automation is the quality gets better, because you have fewer chances for human error. So once you get it up and running and run smoothly, then, you know, you have higher quality, better yields and just a better all-around product. Yeah. Probably take some time for the cost to come down, but, yeah, from a quality perspective it’s definitely been, mm.

Hsu: I feel like he made a big deal out of the fact that it was a domestic manufacturing facility as well.

Page: Yeah. I mean, Apple kind of has changed over the decades.

Hsu: Yes.

<laughter>

Page: Maybe forced into it, I don't know. But back then, first Apple and then NeXT, it seemed like the right thing to do was to build it locally, and I don't know that things needed to go overseas as quickly as they did. <laughs> But if you're going to do really high volume, like the iPhone or something, it's kind of difficult to do that in the States, but I think it's possible. But if you have modest volumes, it's not so clear to me you can't do it here. One of the things it does it is it brings manufacturing and engineering closer together, and, you know, problems get resolved a bit easier, bit quicker, and one thing that happens if you send a product overseas too early is you end up spending lot of time and money and lost time in having people go to Asia or wherever and solving issues, right? The first thing you end up doing is buy plane tickets and...

<laughter>

Page: They add up quickly. <laughs> Plus, you have the travel time and just the average difference, right?

Hsu: Mm-hm.

Page: So Apple had the Mac factory over in Fremont. It was pretty successful. They had a clone of that over in Ireland.

Hsu: Mm, in Cork.

Page: And so the two were basically identical, and so I think it felt natural for Steve to, "Well, we'll do it in Fremont again." <laughs>

Hsu: I see.

Page: Yeah.

Hsu: Yeah.

Page: And it's a lot better to go a 30-minute drive than a--

<laughter>

Page: --nine-hour flight. Yeah.

Hsu: So is-- were they located where Tesla is now or where were they physically?

Page: Oh, Tesla is where the auto company was.

Hsu: Oh.

Page: United Motors or whatever it used to be called. It wasn't too far from that. It was maybe two miles from that or something. Do you know where the Fry's Electronics--

Hsu: Oh, yeah.

Page: --is over in Fremont?

Hsu: Yes.

Page: It was like a few hundred meters from there.

Hsu: Oh, wow. Okay.

Page: Yeah.

<laughter>

Hsu: You mentioned the videos. I think that was also, you know, I think Steve was so proud of the factory, made such a big deal of the factory that he commissioned those videos.

Page: Yeah.

Hsu: What was the purpose of the videos?

Page: Well, just promoting the product and the company and, you know, and I think it was his way of saying, "We have a quality product," and just promotion, yeah.

Hsu: Yeah. But you don't always see the behind-the-scenes, right? Like, a lot of times you just see the end product.

Page: Right.

Hsu: You don't see the making of the product.

Page: But I think he was proud of the achievement, yeah.

Hsu: Mm-hm.

Page: Although it took him a while to find somebody to run the factory.

<laughter>

Page: I think he was proud of what the team had accomplished.

Hsu: Right.

Page: So Steve was really good at, I mean, maybe a number of things, but I think of three things that he was exceptionally good at, and probably the first one was marketing, <laughs> and then maybe the second one is industrial design, mechanical engineering, and then maybe the third is manufacturing, and so one thing I learned working with him was that there was those three items and then there were other things, and if you were working on other things you had a bit more free reign, a bit more rope to get things done. But if you're working on one of those three areas, whether you wanted it or not, you were going to get his help.

Hsu: Right.

<laughter>

Page: Which made it harder. Right. Right.

Hsu: Wait. So this is the first time I've heard that Steve was particularly interested in manufacturing.

Page: Yeah. I think <inaudible>--

Hsu: When did that start? At Apple?

Page: I think early Apple. Are you familiar with, in mechanical engineering when you make a plastic mold, are you familiar with zero draft?

Hsu: No.

Page: Okay. So I don't see a trash can.

<laughter>

Page: If you think of a trash can, a trash can has these sides that are not parallel. They're sloped, and there's two reasons for that. One is after you make the trash can, if they're sloped as they are, they're easier to stack. That's one advantage. The other advantage is they're much easier to put into a mold and pull out of a mold if they have sloped sides, and anything that's plastic, when you mold it and you got to pull it out, if the slides are, sides are sloped, then it's easier to pull out of the mold. If you go to what's called zero draft, and the sides and top and bottom are parallel surfaces, it's almost impossible to pull it out of the mold, and they have these things called pulls, and what happens is they close the pulls up, they inject the plastic, plastic cools down, and then you pull on the pulls and then you pop out the plastic. So a lot of computers and lot of products, you know, were made with sloped sides. They don't look as nice, and Apple's one of the first ones to sort of come in and do zero draft on things.

Hsu: Huh.

Page: Yeah. So Steve understood mechanical engineering pretty well. That was reflected there and in manufacturing. Yeah. The thing that made my life a little easier, <laughs> harder but easier, was although he was very good at industrial design, very good at mechanical engineering, and it took time to get him to the point where he was happy <laughs> with it, I think he understood that once you committed to a design and once you sent it off for tooling, and you've committed a couple million dollars, the train leaves the station and there's no coming back, right. If the cost was only a hundred grand or something and you changed your mind, you could change it. But when the tooling costs a million, two million, three million dollars, once you decide you're going for it, you can't. You can't change it. He understood that, so you get to a point where you make the decision to let it go, and then it, you know, and then you're stuck.

<laughter>

Page: One way or another. So at least he understood that, yeah.

Hsu: <laughs>

Page: I don't know how he came across Hartmut Esslinger of Frog Design.

Hsu: Ahh...

Page: But--

Hsu: Well, he had done work for Apple before, right?

Page: Right. And I don't remember exactly when Hartmut engaged with Steve in Apple, but I think it was around '80 or '81. Don't remember exactly, but what Hartmut would do is he would come up with a theme, and if you think back to the-- not the original Apple II nor the original Mac, but if you think there was Mac SE and there was, like, the Apple IIc.

Hsu: Yeah.

Page: And they were kind of whitish color and a little bit different look.

Hsu: Right.

Page: So Hartmut had come up with something he called the Snow White theme, <laughs> and so after that theme was created, all the products after that were kind of-- fell into that model, and so the Mac fell into that, the Mac II later, the Apple IIc, the LaserWriter. They looked a little boxy and they all had sort of those horizontal lines to them, but they all fit into that, into that theme, and at NeXT, we had Hartmut helping us there as well, and he kind of came up with a theme for the, yeah, for the NeXT products, and we executed within that. So yeah, Frog Design would come up with a concept, first drawings and then later models, and they would spend a lot of energy, lot of money, on making wood models, and, I mean,

they looked beautiful. I mean, the wood models that they made and later the product, you know, other than the fact one's passive, the other one's a product, they all looked almost identical.

Hsu: <laughs>

Page: So the models looked really beautiful, but one thing that enabled is that it enabled Steve to kind of accept it or not, and then we proceeded with it, and so the wooden models were little bit expensive, but at least you got to see-- it's a lot better than just having drawings, right? You got to see in real life what it was going to look like. So I thought that was pretty good. Let's see. I can't remember if we-- I think we talked about this last time, but just for fun we'll-- maybe we'll repeat a little bit. If you want to have a computer in the '80s, there's sort of two problems you got to solve. <laughs> One problem is you have to have a decent screen with decent resolutions, and you have to have a printing strategy that matches, and the problem was in the early '80s, mid-'80s, color monitors were fairly coarse. You end up with large spot sizes, which means you end up with big pixels, which means it's hard to put even a half page of text on the screen. So the early Apple product, early NeXT products, were all black and white, and when the NeXT computer came out, you know, in '89? <laughs>

Hsu: Eighty--

Page: Think it got announced October '88.

Hsu: Yeah.

Page: Kind of shipped early '89.

Hsu: Right.

Page: Yeah. I think some people thought, "Oh. Steve and Rich and George are color blind."

<laughter>

Page: They're still doing black and white.

Hsu: I remember you mentioned that.

Page: <laughs> I thought that was kind of funny, and it wasn't so much that the company was color blind, it was that it was hard to do the same thing in color, and even if you could get a decent color monitor, then there was no printing solution, right, and so first the color monitor problem got solved, then later the printing problem got solved, but it took a few years. Yeah. So I thought that was entertaining.

Hsu: You were also in charge of procurement of parts from the suppliers?

Page: Not so much in charge, but both at Apple and at NeXT I helped out a lot.

Hsu: Okay.

Page: Yeah, and I kind of ran interference with some of the suppliers, yeah.

Hsu: I see.

Page: Yeah.

Hsu: So what exactly did you do in that role or I don't know if it was a role.

Page: Okay. So one of the big relationships I had [was] with Motorola, and, you know, Steve was pretty aggressive with employees, but he was sort of equally aggressive with suppliers, but lots of times suppliers didn't know how to respond when Steve started yelling at them, <laughs> and what they should've done is pushed back and argued with him, but, you know, if you're the CEO or GM of a large supplier, you kind of think, "Well, the customer's right." You don't really want to fight with the customer, but Steve loved to have arguments with people, and it didn't really matter whether it was employee or the supplier, so-- but that was hard for the suppliers, so the suppliers kind of tried to get away from that. <laughs> They really didn't want to meet with him, some of them. Like, the Motorola guys were just afraid of him. They're like, "No," <laughs> "we don't want to meet with him." So I ended up being sort of the go-between in some cases at Apple and definitely at NeXT, between Motorola and the company, and part of it was just insulating them from Steve. Part of it though was, what was interesting, was the Motorola guys didn't want to bring their own salespeople to the meetings, because they were afraid the local sales guys would be leaks of information, you know. So every time I met with somebody from Texas, you know, most of the teams were either in Austin, Texas, or down in Arizona, every time I met with one of them, the one meeting turned into three meetings. Because I met with Motorola, I'd meet with Steve, fill him in [on] what happened, and then often I'd meet with the local sales guys kind of. I wouldn't tell them everything but I'd kind of fill them in with the highlights so that they were clued into, and so it's like, yeah. Every meeting turned into three or four meetings. Was kind of fun.

Hsu: And you also had to deal with Canon?

Page: Did a lot with Canon. You know, Sony was big in monitors, and that was a big supplier both at Apple and at NeXT, on the monitor side.

Hsu: Oh. So they supplied the tube for the MegaPixel display?

Page: Yeah. Sony did the black and white one.

Hsu: Right.

Page: We had a little trouble getting the color monitor from them once we moved to color, because they were having trouble making enough, so that was kind of a challenge. But Canon, of course, you know, did the laser printer.

Hsu: Right.

Page: So it was a Canon engine with an Apple or a NeXT enclosure and Apple or NeXT electronics.

Hsu: So why stick with Canon? You had said, "We worked with Canon at Apple--"

Page: At Apple. I think we viewed them as the leader.

Hsu: I see.

Page: Yeah. There was one point--

Hsu: So not Xerox? Not-- <laughs>

Page: No. I mean, we kind of gravitated to Canon as being sort of the leader in engines, and there was one point where I remember where Steve got frustrated with Canon and he'd sent Bruce and I off to go and do a little research as to alternatives, <laughs> and we ended up talking to couple other companies in Japan and, I don't know. After a few months we gave up and went back to him and said, "No. Let's just stick with Canon," <laughs> and whatever was bothering him kind of blew over, and <laughs> we stayed with Canon, yeah.

Hsu: Was it because they were just ahead of everybody else or...

Page: Yeah, I think so. They're, I mean, they had a good product and good quality and, yeah, so I think they were clearly number one at the time. Yeah. You mentioned Xerox and--

Hsu: Yeah.

Page: And I think we've talked about it before, where the guys at Xerox PARC were doing, you know, Smalltalk and the computer and everything, and I thought it was funny that those guys would make trips back to Rochester, New York, and they'd present what they'd been doing on the computer side, but everybody back in Rochester was focused on copiers, and every time they went back, they did make a trip like once a year, and every time they went back and presented, the feedback they got was, "That's not a copier." <laughs> Which I thought was a strange reaction. So it's funny that Xerox never really did much with the, you know, with everything they did at Xerox PARC.

Hsu: Well, they did do, they did the laser printer.

Page: Some.

Hsu: They made--

Page: They did some, but it really was Apple and NeXT and Microsoft that really, you know, made it happen in the world.

Hsu: But Xerox was big in laser printers.

Page: Yeah. But I was thinking--

Hsu: They invented the laser printer, but they--

Page: But they were ahead in word processing and object-oriented programming and had all this technology, and they couldn't quite turn it into products and get it to market. Yeah, and they had some interesting stuff.

Hsu: Yeah.

Page: Yeah. I just thought it was-- the reaction down at Rochester I thought was comical.

Hsu: Right.

Page: "That's not a copier." <laughs>

Hsu: And NeXT, did NeXT hire people from out of Xerox PARC? I seem to remember some-- there were a few people who came out of PARC to NeXT.

Page: Well, I remember we hired a couple at Apple, and I don't remember if we hired anybody directly into-- from Xerox or not or whether some came through Apple to NeXT. I don't remember. Yeah. But yeah, all kind of one community, yeah.

Hsu: Is there any more you wanted to say about the laser printer and the design of the printer, the manufacturing of the printer?

Page: I mean, I guess the impressive thing was that it was really the first laser printer solution you could buy, right? I mean, Mac plus the LaserWriter, the LaserWriter was the first one.

Hsu: Right.

Page: Yeah.

Hsu: But, actually, I mean the NeXT laser printer.

Page: Oh, the NeXT one. So one thing we did, you know, at Apple, it had a fairly large computer, 68000 [CPU], lots of memory, and it imaged the page inside the printer. At NeXT, we imaged the page in the

computer and we shipped the bits over to the printer. There was very little electronics in the LaserWriter, or laser printer at NeXT, and so that helped bring the cost down.

Hsu: Right.

Page: Yeah.

Hsu: Yeah, okay.

Page: So that was a big deal.

Hsu: Right.

Page: Yeah.

Hsu: And NeXT could do that because it had Display PostScript in the computer?

Page: Had Display PostScript and that helped too, because then you had one imaging plat-- you know, paradigm that was both for the screen and for the printer.

Hsu: Right.

Page: Yeah. So that was a big win.

Hsu: Right.

Page: Yeah. Another thing that happened, don't know if we should-- we can talk about a little bit of it now and then we'll follow-up when we talk about my first startup. <laughs> So the other thing that happened when we started NeXT was networking was just starting to come into play in the world, because back in 1980, there really wasn't any networking and everybody just carried stuff around on floppies, <laughs> and as we got to the mid-'80s, you know, Apple had done AppleTalk, which was kind of a low bit rate networking at 230 Kbaud, but Xerox was working on Ethernet, and I think they started in the late '70s, and Robert Metcalfe left Xerox around '80, '81, something like that, and founded 3Com, and 3Com was big in Ethernet. It took them a few years to, you know, bring that to market, but 3Com was doing quite well with Ethernet, about the time that NeXT got formed. So one of the things we decided was we wanted to have, you know, 10-megabit Ethernet that integrated in the product. So rather than buying some chips, we integrated into the chips that we had.

Hsu: Why was that an important feature?

Page: Well, fewer parts on a board, higher integration, really.

Hsu: Yeah. But why was Ethernet itself so important?

Page: Oh, why was the network important?

Hsu: Yeah.

Page: Just because people were starting to move towards networking in a big way and--

Hsu: In the industry?

Page: In the industry, and I think it was a, you know, large part of the platform was seen as, you know, the screen, yeah, the memory, the processing, and networking, right. I know we talked about the 3M machine being a megapixel, megabyte of memory and one MIPS, but I think it's easy to add networking on that too because without networking those stand-alone workstations aren't as useful.

Hsu: Right.

Page: Yeah, yeah.

Hsu: In the workstation market, especially the UNIX workstation market.

Page: Especially the workstation market, yeah.

Hsu: They were all networked.

Page: Yeah.

Hsu: With Ethernet.

Page: And that, you know, sort of over time drifted down into the personal computer space, right. Yeah. So we decided early on at NeXT we wanted to do 10-megabit Ethernet, and I looked around and tried to find a solution that we could license, and I couldn't find anything. <laughs> I remember talking to AMD and they're like, "No, we don't want to license it." "Well, just buy our chips."

<laughter>

Page: And I said, "Well, not really interested in your chips. We want to do our own." So I ended up hiring a couple guys and we ended up doing our own from scratch, so that was pretty successful, so a challenge but successful, yeah. We'll come back to that. Right.

Hsu: Yeah. So I guess to finish off this sort of topic, so on your resume you said, it says, you spearheaded design engineering, materials management, manufacturing, service, order management, and distribution as general manager of the NeXT Hardware Division.

<laughter>

Page: Well, in the beginning there I was, you know, just doing hardware, right? Just engineering, but that was a big part of my time. But we got to the point where Steve needed somebody to run the factory, and so I ended up doing that, and so I ended up picking up all these other things. So I ended up picking up the factory, order management, all the factory-related stuff. Yeah, so-- and, you know, it made it a little hard for me to have two jobs, but I think the one big benefit was it was easier for Steve.

<laughter>

Page: And if Steve's less frustrated, then everyone's less frustrated, so...

Hsu: Right.

Page: I decided, well, maybe a little harder for me but probably better for the bigger picture. Yeah.

Hsu: And were, I mean, you hadn't done this before, right? So how did you learn this new skillset?

Page: Yeah, you're right. I hadn't. I'd been involved with the factory to some degree at Apple, but I never managed it. Right.

Hsu: Right.

Page: And-- but it was mostly an engineering problem, right, because the NeXT factory was largely engineers and materials people, and a relatively small number of hourly people.

Hsu: Right.

Page: Yeah. So it was more of an engineering problem than a-- it's not just a brute force assembly problem. We had a few hourly workers, but not as many as you'd think, right. Yeah. Mm.

Hsu: Hm. Were there any-- what sorts of difficulties or complications or problems did you solve in manufacturing?

Page: So one problem we had at NeXT, with the first product, which we fixed later, the monitor was plastic. <laughs> The keyboard was plastic. The printer was a plastic enclosure over, you know, metal. But the cube, the NeXT cube, was a magnesium structure but painted.

Hsu: Right.

Page: And as it turns out, I think that was a mistake. <laughs> Because it's hard to take a cast, something, whether it's cast aluminum or cast magnesium, it's hard to take something that's cast, sand it, get it the right texture, paint it, get it the right color, and have it, that whole process, be repeatable. So what we did later with the black and white NeXTstation and the color NeXTstation, we had these things called the pizza box, right. <laughs> What we did is we did a cast aluminum structure with a plastic outer

structure, and the nice thing about that is you get this plastic cover the right texture and the right color and then it's easy to make lots of them. If you have a cube and they got to get sanded and they got to get painted, then they all vary a little bit. You end up with Steve coming to the factory and saying, "I don't like that one." <laughs> You know, because they were variable, right, and so what we did at one point is we built a matrix of different textures and different colors, and, I mean, not dramatically different but shades, right, and we got Steve to buy off on, "Okay. If they fit into this rectangle, these shades of gray are okay and this shades of-- this variation of texture's okay and something outside that rectangle's bad, but if it fits inside here, then it's going to be okay."

Hsu: Okay.

Page: And it took him a while to buy into that, but...

Hsu: <laughs>

Page: But that made life a lot easier, because then you didn't have to ask him, you just, you knew, right? Yeah.

<laughter>

Page: And if he varied, this solved that problem.

Hsu: Right.

Page: Yes.

Hsu: Right.

<laughter>

Page: Because I swore sometimes, you know, there was something he didn't like and yet a week or two earlier it was okay.

Hsu: Right.

<laughter>

Page: You know, so you don't want to deal with the whims of he doesn't like it today, right.

Hsu: Yeah.

Page: Yeah.

Hsu: <laughs>

Page: So that was a problem.

Hsu: I think your resume mentioned that you helped reduce the field failure rate, so what sorts of failures were being encountered?

Page: Our biggest problems were not with-- I don't remember what our computer failure rate was. It was pretty low. Our biggest problems were with monitors. <laughs>

Hsu: Oh.

Page: And slowly over time we got various monitor problems solved, and I don't remember the name of the city, but there's a small city or town down near San Antonio, Texas. It can't be real big, but there's some university down there, and we were shipping systems and monitors to this university near San Antonio, and every time we'd ship one, the computer would get there and the monitor would get there, but the monitor wouldn't work.

Hsu: Oh.

Page: And what was happening was apparently the road from San Antonio out to this smaller town was a pretty washboarded road, pretty rough road, and it's on the back of the FedEx truck and "d-d-d-d," and by the time the thing got to the customer, you know, the monitor was basically shaken apart, right? <laughs> And so it took us a while to, you know, to solve that. Yeah. But we had-- so we slowly fixed the monitor issue that-- monitors are-- monitors are a lot complicated than they appear to be, right, and then if you have sort of product quality issues with them it makes life even tougher, yeah, so...

Hsu: So how did you solve that problem?

Page: Just finding problems one by one and fixing them and...

Hsu: So was it an issue with the packaging or was it an issue with--

Page: Partly packaging, but also partly structural issues with the monitor back at the factory.

Hsu: Oh.

Page: A lot of monitors have a little board on the end. There's the neck of the tube and there's a little board.

Hsu: Ooh.

Page: And they had, in this case, there was a little metallic band that gripped onto the tube, but this piece of metal that gripped onto the glass tube wasn't real-time, and sometimes it was, what was happened, was really simple, is this little board on the back of the tube just fell off in transit, and so had to go back to the supplier and say, you know, "You got this metal band attached to glass, and that's okay, but if there's too much vibration the board falls off," and so we had to get that changed and fixed. That was an example.

Hsu: Okay.

Page: So...

Hsu: Were there any issues with the optical drive?

Page: Yeah. It was pretty solid, but I remember last time we talked about the fact that eventually we augmented the system with a small hard drive, and I think once we did that, the system was <inaudible> beating up on the optical drive less, <laughs> but when the system was first built and you had systems that were optical drive only and you had Unix swapping to the optical drive, not only was it slow but it was really banging on the optical drive a lot, and we-- and so we had some early failures on the optical drive that we had to go chase down and get fixed. But Canon was pretty good about that.

Hsu: Oh. So they supplied the optical drive as well.

Page: They supplied the first optical drive. Right. Yeah.

Hsu: Wow.

Page: So the optical drive was a Canon mechanism with Canon analog electronics and NeXT digital electronics. So the electronics was split between NeXT and Canon, and Canon had responsibility for the mechanism, so-- but, you know, I think having the system swapped to the optical was, you know, kind of hard on the optical. There was a lot of accesses and there wasn't-- <laughs> wasn't really planned out. I mean, nobody was thinking it was going to get beat up that badly.

Hsu: Right.

Page: Yeah.

Hsu: And, I mean, that probably could've been anticipated if the, I guess, the hardware and the software teams had communicated more?

Page: Maybe. But I think it was also maybe a factor of not realizing how big the working set is for the software versus how big memory is, right?

Hsu: Ah.

Page: I mean, we kind of talked about this last time with, you know, back at Apple, whether it was Lisa or Macintosh, you had this issue of you try for a certain level of functionality, you got to make memory big enough to cover that, and, you know, sort of had the same problem at NeXT, but given Unix has some-- virtual memory-- in that swapping, better supported in that operating system, then the line isn't so bright as to where you need more memory, right, and--

Hsu: Oh, okay.

Page: And so what happens, the system runs slower, but it runs, right?

Hsu: Right.

Page: It doesn't run out of memory right away. Right.

Hsu: So the software people didn't feel as hard of a constraint.

Page: There wasn't a hard limit. There wasn't such a hard limit as--

Hsu: So they would put more features into the system which would increase the swapping because the memory stayed the same.

Page: Computer guys like to do that, right?

<laughter>

Page: Or the CEO likes to do that.

<laughter>

Page: So as you can imagine, and I think every company goes through this argument, there's always the argument of the product would be just so much better if we had this one more feature, <laughs> and I think every product goes through that, every company goes through that to some degree. I guess I'm of the camp of, yeah, features are important, but once you got enough features, you start adding one or two more, does it really help that much, right? And it depends what they are, but a lot of times it's like there's enough and the product's useful, adding a couple more small features doesn't really, unless they're big things, it doesn't really matter, right? So some people describe this as the definition of the computer is like the top of a mountain, and the top of the mountain's very flat.

<laughter>

Page: And you can create little peaks up there with different features and you can sort of say, "Well, if I'm up over here with this extra feature, then it's that much better."

<laughter>

Page: So I want to be up here, feature-wise, right, and I don't know that that's true. As long as you don't fall off the edges of the mountain.

Hsu: <laughs>

Page: Long as you're somewhere on the top of the plateau, eh, you know, adding a couple extra features doesn't make that big of a difference, you know, and I think we've all experienced cases where-- I'll pick on sales for a minute-- <laughs> we all, in a lot of companies, we've all seen cases where the sales guys come in and say, "If I just had this one extra feature, I could sell 50 percent more product," you know, and sometimes it's true and often it's not, right, and sometimes you just got to get sales and marketing to sell what they have.

<laughter>

Page: And there's a sort of tug-of-war between product and sales and marketing and stuff. What's the right feature set? Right, yeah. But, you know, Steve liked to add features. But the comical part, I thought, was he would come and he'd have some new feature he'd want to add and it's late in the product cycle and he'd be arguing for something new and he would try to construct an argument around, "Well, if you add this feature it's actually going to be easier to do this. We're going to get done sooner."

<laughter>

Page: And I'm like, "Mm, I don't buy that."

<laughter>

Page: And so when we were first at NeXT and we were only doing one product, it was kind of hard to avoid those discussions because there's just one product and he wanted to optimize it. A bit later, when we had two or three projects, life was a little easier, because if he comes into your cubicle and he wants to talk about one, then your goal is to distract him with something else. <laughs> So if you can distract him with another project, get him off the one he wants to talk about, distract him with another one, that's good because you can let that other one continue. <laughs> So that happened quite a bit.

Hsu: Can you talk about the launch of the Cube in October of '88?

Page: So I don't remember too much other than it was at Symphony, at Davies Symphony Hall up in San Francisco, but did you guys ever talk to, like, Mitch Green or any of them?

Hsu: I'm not sure.

Page: Okay. So I'm thinking it was Mitch was the sales engineer that was supporting Steve. I might have the name wrong, but I think it was him, that was supporting Steve during the, you know, the whole product announcement, and we'd gotten to the point where, you know, the hardware had been pretty solid for, mm, a year or two. The software was still evolving. When we got to October '88 and wanted to, you know, make the product announcement, you know, Steve wanted to do a demo up at Davies Symphony Hall, in front of, I don't know, what was it, 2,000 people or whatever it was, and the problem was the software wasn't perfect yet, <laughs> and-- but it was very good, but it's just that the chances of doing a demo for 30, 40, 50 minutes and having the system run flawlessly, you know, that's not going to happen.

<laughter>

Page: So what we did-- I don't know if the world knows this, but what we did was we constructed basically one monitor, one keyboard, one mouse, with a switchbox to two computer systems, and then there was actually two switchboxes, one for Steve and actually one for Mitch, and while Steve was doing the demo, the demo was kind of scripted. Mitch knew what Steve was going to do and what he's going to say, and so Steve was going through the demo, but if it crashed-- when it crashed, it usually just hung, right? So when it crashed, what Mitch would do is he'd switch the two switchboxes. Steve would have Mitch's system and Mitch would pick up Steve's. Mitch would go reboot that system, get it back up to where Steve had it, and there was probably a 15, 20-second pause while Mitch was swapping the two, right? And so Steve was doing the demo and then there was suddenly this sort of sudden pause and then Steve would kind of talk for 30 seconds or so and then continue.

Hsu: Oh, wow.

Page: And I think all the employees knew what was going on. I don't think anybody in the audience realized, right.

Hsu: <laughs>

Page: So it was kind of funny, and I think Mitch, during that 45 minutes or so, I think Mitch had to do it, like, once every 15 minutes or so.

Hsu: Oh, wow. <laughs>

Page: So, you know, it wasn't, you know, as a single system straight, unless you want to have it being rebooted in front of the audience, it wouldn't have survived, right. Yeah.

Hsu: <laughs>

Page: But that's life.

Hsu: <laughs>

Page: It was still early. <laughs>

Hsu: Yeah. And, you know, so that was the first time the world and the press got to see the product.

Page: Yeah.

Hsu: What was the reaction?

Page: Well, I think was very positive, yeah. Yeah. I mean, I don't remember too much into the details. That was--

<laughter>

Page: That was a while back, yeah.

Hsu: Right.

Page: What's that, 30 years now?

Hsu: Yeah. Yeah.

Page: <laughs>

Hsu: Yeah. It's just past 30 years now.

Page: Yeah.

Hsu: <laughs>

Page: But it was very successful, I think, yeah.

Hsu: The launch.

Page: Yeah.

Hsu: Yeah. So then how were sales afterwards?

Page: So I think, you know, I think sales were good for the first, you know, four, five, six months, and then as what happened with most computer systems, I think sales softened a bit and then eventually, you know, started to go up again. But the numbers were not, you know, the numbers were a bit disappointing.

Hsu: Right.

Page: Yeah. And, you know, probably part of that was the product was more expensive than it should've been probably.

Hsu: Yeah.

Page: Yeah. Mm.

Hsu: Were you involved in the move of-- so there was a deal made with Businessland to sell the Cube to businesses, not just education?

Page: Right.

Hsu: Were you involved in that at all?

Page: Just sort of on the fringe. I mean, I think I met-- Kevin Compton was with Businessland, and I think when Todd [Rulon-Miller] and Dan'l [Lewin] put that together with Kevin, you know, I met Kevin once or twice, but that was really Todd and Dan'l's <laughs> thing, yeah. So you can talk to Dan'l.

Hsu: Yeah, talk to Dan'l about that.

Page: <laughs> You got an inside source, yeah.

Hsu: Right. <laughs> What about the--

Page: But I really liked Kevin. I thought he was good. Yeah. Yeah. I still see, I mean, I don't see him very often, but I still see him occasionally, yeah.

Hsu: And then the IBM deal was-- did you have any involvement in that?

Page: A bit. So the one place I got involved was I think we talked a little bit about the lawsuit between Apple and NeXT and Dave Balabanian had defended Steve in that six-month period, and Gary Moore was defending me through the deposition phase, and I don't remember which year, but that was '86 and it got wrapped up early '87, and I don't remember what year it was, but we went back to Gary a few years later and got him to come on board as the general counsel at NeXT. So do you remember what year the IBM deal was? I don't.

Hsu: Not exactly, no.

Page: Yeah. I'm guessing it was '89 or '90.

Hsu: Sounds about right.

Page: Yeah. So Gary was already on board, and as part of that, since the two companies wanted to do business together, you really don't want to be fighting over patents.

Hsu: Right.

Page: And so both companies were motivated to do a patent cross-license, and maybe we were a bit more motivated than them, but Gary and I went back to Armonk, New York, and we negotiated a patent cross-license with IBM, and it was all of ours in trade for all of theirs.

<laughter>

Page: And it was a bit skewed.

Hsu: <laughs>

Page: Yeah. But, you know, it was partly we had a few patents that had some value. They had many.

<laughter>

Page: But both parties wanted to do the cross-license. You know, I think the fact that both parties wanted to do it was entertaining. Made it happen, yeah. Patents are-- I find patents an interesting thing, because you do a-- they're a little bit like movies and products, only maybe less predictable. You do a lot of patents and at the time you do them you don't really know which ones are going to turn out to be higher value and which ones are going to be lower. If something's not worth much, then why would you spend 15, 20, 30 grand getting the patent, right? <laughs> But you don't, often, you don't know which ones turn out to be valuable.

Hsu: Right.

Page: So I remember around 1980, RCA came to Apple with a patent and wanted to extract a royalty payment from Apple, and RCA had-- so let's do a little bit arithmetic here. Well, must've been 1964, 1965. RCA got a patent for putting characters up on a tube, and, you know, in 1990 you could ask, "How's that possible?" right? But I guess back in 1964, 1965, it was new, it was unique, right. There were relatively few computers and relatively few monitors, right. There were teletypes and things but relatively few monitors and the idea of putting characters up on the screen, you know, RCA had a patent on it, and that was about ready to expire. I guess it expired in '81 or 2 or something. It was about ready to expire and I guess RCA noticed, you know, Apple shipping personal computers and RCA came in and tried to extract a royalty from Apple. Yeah. I don't remember exactly how it all got settled, but it was near the very end of the 17 years. So the other thing I've noticed about patents is that if you're a really big company, you probably have a plan and you probably spend a certain amount of money every year. It's a large amount of money, but you spend a predictable amount of money every year just getting patents done and filed and everything. When you're smaller, it's harder, because every patent costs 20, 25 grand, and maybe you have the budget and maybe you don't, <laughs> and if as the company's growing,

if you go through periods where cash is a bit tighter, you get to the point where you question, “Should we be doing patents this year?” <laughs> And so you don’t really want to have the answer be, “No,” but sometimes smaller companies can’t afford them, right. I mean, hopefully you can afford them, but sometimes small companies feel like they’re cash rich and sometimes they’re cash poor, right? And so when I saw a little bit at Apple early on, I saw at NeXT, there were points where the company was wanting to do more patents and there’re other times when-- didn’t go all the way to zero but the company wanted to pull back. Yeah. So 1985 at Apple was a pretty lean year, and, you know, that’s an example of when, “Oh, maybe we don’t want to spend a whole bunch of money this year on patents,” right, and NeXT kind of went through that too. Yeah. But, you know, they’re like movies. I mean...

Hsu: Yeah.

<laughter>

Page: Nobody would make a bad movie and take it to market, right, if they knew it was a bad movie, right?

Hsu: Right.

Page: I mean, I don’t think.

Hsu: Yeah.

<laughter>

Page: But sometimes you watch a movie and you sort of say to yourself, “Didn’t they know it was bad?”

<laughter>

Page: So I think the same thing applies to patents.

Hsu: Right.

Page: Yeah. <laughs>

Hsu: So why do you-- what was the primary reason, do you think, that the Cube was not successful?

Page: I think the big reason was it was too expensive. Maybe a secondary reason was we were approaching 1990, and it was still black and white. <laughs> Because a lot of customers were like, “Well, how come the NeXT product isn’t color?” But I think the bigger issue for the Cube was the cost.

Hsu: Right.

Page: When we did the NeXTstation it was, you know, the pizza box design, and it was quite a bit cheaper. So I'll leave a name out of my next statement, just to protect the innocent. But I hired an engineer. He was very good, and I brought him on board in the spring of I think 1990, and he was going to work on the color NeXTstation, and I remember we were in the lab one day and he had just started a few weeks earlier and we're in the lab and Steve's there, and Steve's making the point, "We got to get this done by October." So we have a discussion for a while and eventually Steve leaves, and then he and I are talking about this, and he says to me, "Well, I don't understand. Obviously he doesn't mean this October because that's impossible. But October next year is like 17 months away." <laughs> "He can't mean next year, but he can't mean this fall, so..."

<laughter>

Page: "What's going on?"

<laughter>

Page: And I said, "Well, unfortunately he means this October."

<laughter>

<1:00:35>

Page: So I always wondered, I don't know about at NeXT. Have to think about it, but I always wondered when I was at Apple, you realize that almost every project at Apple took three or four years to get out the door. But every project at Apple was started with a nine-month schedule. <laughs> So why was every project a nine-month project but they took three to four years, right? That's not off by 10, 20, 30 percent. I mean, that's a big factor, and I never really came up with a good answer to that, but I had two thoughts. One is I don't think Steve trusted engineering. I think he thought, "Whatever schedule I give them, they're going to double or triple it. So I might as well give them a shorter schedule." I think that was part of it. But I also think that if he went to Mike Scott and the board and said, "I need nine months," then they'd probably say, "Yes." But if he were a little more honest and say, "I need two and a half years," they might say, "Ooh, that's too much money," and maybe they would've not agreed, right. So I think maybe he sold it to Apple based on the fact that, "Well, it's only nine months. We can afford it," right, and then when it took three years or four years then, "Oh, well." <laughs> So I think it was partly selling it to other parts of management and I think it was also defending himself from engineering. <laughs> But nothing ever took nine months, right. So I guess when I was at Apple I-- I learned something at Apple which I guess is obvious to people, but I'll tell you anyway. So what happens is you get your product done and at some point it's done on this day but it doesn't go out the door for another three, four, five months, right? But at the point where you freeze it internally and it's going to go out the door in three months, you can't make any more changes. <laughs> Because there just isn't time, right. But that doesn't mean that people don't want to make changes, don't have ideas. So what happens is the day you freeze the product, from that point on, people start accumulating out things they want to change about it. So then you get-- so then you ship the product and then you're-- it's six, nine months later, and somebody in engineering has a

bright idea of making some small change. So what they want to do is they want to open up the product, make some small change, close the product back up and ship it. That turns out to be nearly impossible, <laughs> because the minute that other people realize that you're going to change the product, everybody comes out of the woodwork with the three things they want to change. There is no, there are no small changes. There's no two, three-month small change projects, right, because as soon as the world finds out that the product's changing, all of a sudden it turns into a bigger project. The only ones that happen in a shorter time frame are ones where there's no outward change to the product and it's just cost reduction, right. It's totally, totally transparent to the user. So you can do things to reduce cost, provided you don't change anything about the product. But once you start changing features it's... <laughs> There are no small projects, <laughs> yeah.

Hsu: Could you compare the market reaction to the Lisa and to the NeXT?

Page: I guess it was similar in the sense that they were both more expensive than they should've been. Yeah. And so sales were a bit weak in both cases because of that, yeah. So, you know, maybe [if] things had been a little different maybe they both would've been a bit more successful, but I think in both cases the price was too high.

Hsu: Right, and they were both probably too ambitious technically?

Page: Yeah, I think so.

Hsu: <inaudible>

Page: Or maybe, you know, maybe in both cases, especially in the case of Lisa, maybe the memory was the overriding factor and the single biggest problem with Lisa I think was the memory requirement and the cost of memory at that point. Now, had the product gone out the door two years later and memory was half the price, maybe would've been less of an issue. <laughs> So there was sort of Lisa 2 or Mac XL or whatever you want to call it, right? That one did pretty well, and then it was 18 months later, so-- and then the bigger memory was more affordable, yeah.

Hsu: What other similarities do you see between the two?

Page: Not sure that--

<laughter>

Page: I'm not sure if I have anything there for you.

Hsu: Yeah. I find it very interesting is that because you worked on both products, especially, right?

Page: Yeah. I worked on both, I mean, I helped out on Mac, yeah, yeah. You know, although Steve got out of the Lisa, <laughs> after a period of time. I mean, he had a big say on both, yeah.

Hsu: Right.

Page: Yeah.

Hsu: Right.

Page: It's hard to say what the right feature set is and where you draw the lines on things like memory and stuff, right, yeah.

Hsu: But you feel that both could've been successful had the price been lower?

Page: I think so. Yeah. I mean, the NeXTstation, you know, was quite a bit cheaper and did better, yeah, so-- and then when we came out with a color NeXTstation, that started to take away that problem the customers were having. Yeah.

Hsu: So those products, they were introduced in 1990?

Page: I was thinking they were '90-- could have been late '90 or early '91.

Hsu: I think I have it written here, September 1990.

Page: Okay.

Hsu: For the--

Page: So probably introduced it in the fall and it shipped <laughs> early the following year, yeah.

Hsu: Okay, yeah. And then there were Turbo versions that shipped in 1992 that were–that bumped the CPU up to 33 megahertz.

Page: Yeah. And then we had, I don't know that it ever made the light of day, we had a RISC-based version of those.

Hsu: Right.

Page: But I don't know that they ever shipped.

Hsu: I don't believe so.

Page: No.

Hsu: I want to ask, I do want to ask about the RISC workstation, but actually I want to ask about those NeXTstation products first.

Page: Okay.

Hsu: So the, you know, when it became clear the, you know, the problems of the original Cube, how quickly did everything transition to the NeXTstation products and the features of the NeXTstation products, how quickly were those decided on?

Page: Well, I guess it took-- and we took a few months to get the first one out and then it took probably another six months to realize, you know, we got to make some changes and we need the cost reductions, right.

Hsu: Right.

Page: And so, we're probably looking at late '89, early '90 before we started in a serious way getting those things out the door.

Hsu: Right.

Page: Yeah.

Hsu: Yeah. And I guess, were the changes obvious you needed?

Page: I think so.

Hsu: You needed the hard drive. You needed to get rid of the optical and put in a floppy.

Page: And needed to make the packaging simpler. <laughs>

Hsu: Right.

Page: I mean, that whole magnesium cube was kind of interesting but expensive.

Hsu: Right.

Page: Yeah.

Hsu: And the, I mean, just the change in form factor from the Cube to a slab was significantly better.

Page: It helped. Yeah. Yeah. And one thing you'll notice is right or wrong, the NeXT Cube was expandable, right.

Hsu: Ah.

Page: It had four slots.

Hsu: Right.

Page: And, you know, when we went to the NeXTstation, we went back to, you know, no expandability.

Hsu: Oh, I see.

Page: And, you know, you do no expandability, the packaging gets simpler.

Hsu: Right.

Page: And the product gets cheaper. And the problem is customers say they want expandability but it's not clear they want to pay for it.

Hsu: Right.

Page: And you might remember in the same time frame, Apple was struggling with the same problems with the Mac II. And, you know, eventually, Apple comes out with the Mac IIfx and I think it cost like $13,000-$14,000 grand.

Hsu: <laughs>

Page: And it, surprise, surprise, it didn't sell very well.

Hsu: Right.

Page: You know. And so, so the problem is sometimes companies end up delivering to the customer what they ask for and then you get there and then the customers don't want it, right. Or they don't want to pay for it, right.

Hsu: Right.

Page: And so, and one of the biggest issues, you know, back then, 30 years ago, was “do customers want to pay for expandability or not,” and I think the answer was no. So, Lisa had some slots. The Mac didn't. The NeXT product, Cube had some expandability. That's a plus over the Mac too. And it's not clear to me that although customers say they have to have it, it's not clear whether they want to pay for it.

Hsu: Right.

Page: Yeah.

Hsu: Well, that's interesting because I think--

Page: I hadn't thought-- You asked what was the similarities and--

Hsu: Right.

Page: One big similarity between Lisa and Mac II and the NeXT Cube, it was all, they all had expandability.

Hsu: They were all expandable.

Page: Yeah.

Hsu: And--

Page: And the other thing it does is it drives up the cost of the power supply, too.

Hsu: Oh, okay. Because it--

Page: Because you have to have a power supply cover.

Hsu: To cover all the slots, yeah.

Page: To cover all the slots.

Hsu: Yeah.

Page: Yeah.

Hsu: That's interesting because Steve has sort of this reputation for being anti-expandability and yet the first NeXT product was expandable. That I had not really--

Page: Yeah.

Hsu: That sort of-- So maybe that reputation is unfounded or--?

Page: I guess I would say most of the time he didn't favor expandability. But that doesn't mean from time to time he didn't get confused and think maybe we should. I mean, this is one of these issues where you're on the fence and should you do it or should you not, right, and--

Hsu: Right.

Page: And I think he was--

Hsu: Was he convinced by people to do it? Because, particularly because the NeXT was going to education and maybe that market?--

Page: Yeah. And--

Hsu: Higher education thought they needed expandability?

Page: So for example, for example, one thing the NeXT Cube had that the NeXTstation didn't have was, you know, we had the four slots on the NeXT Cube, we really only, I want to say we really only had two boards. We had the CPU board and we had the 3D graphics card <laughs> and-- the 3D graphics accelerator, right. And but when we did the NeXTstation we dropped the expandability, the 3D graphics, you know, fell off. Now we could have built it in but the cost of doing so seemed kind of high.

Hsu: Right.

Page: But some customers really, really, you know, liked, you know, the graphics card.

Hsu: Right.

Page: Now, I guess it's a bit comical, but one of the features that was on the, only on the Cube and only on the 3D card was that card also did NTSC video in.

Hsu: Oh.

Page: And put video in a window.

Hsu: Oh.

Page: And the only way you could get that was [the] Cube, 3D card and you plug your composite video in.

Hsu: Right.

Page: And guess where that was the most interesting?

Hsu: Hollywood or--? <laughs> No?

Page: The agencies.

Hsu: Oh.

Page: CIA and others.

Hsu: Oh.

Page: So NeXT had three markets. So, NeXT had Higher Ed and then finance and then had government agencies. And you might ask, well, why did government agencies care about video in a window. Well, I guess because everybody that worked for the CIA that had a NeXT Cube also wanted to watch CNN in a window and this eliminated a TV off their desk.

Hsu: I see.

Page: So, being able to put CNN in a window on the NeXT Cube, you know, was a big deal for them, right. Yeah.

Hsu: Really.

Page: So.

Hsu: So that was, was that the reason why when the NeXTstations came out there was also an upgraded Cube that was also, like, the high end of that lineup?

Page: That may have been more of an accident of timing.

Hsu: Because it was a color Cube.

Page: Because the--

Hsu: Oh, okay.

Page: The 3D accelerator card wasn't available when we, you know, when we had the first product, right.

Hsu: Oh.

Page: And it wasn't till like 15, 18 months later that we got that done.

Hsu: Oh, I see. Okay.

Page: And maybe that was a little later than we wanted it to be but we had-- we had had help from one of the suppliers on that. <laughs>

Hsu: Oh.

Page: Being late. <laughs> And so, yeah.

Hsu: Because that was a 32-bit color card, right?

Page: Yeah.

Hsu: Yeah, so it was a full color.

Page: It was full color and it had a processor for doing the 3D graphics. And it had the NTSC in a window, right.

Hsu: Right.

Page: And so it was a neat-- it was a neat card, yeah.

Hsu: So, so that worked back to the original Cube?

Page: Yeah.

Hsu: Or did it only work with the second Cube?

Page: Oh, any Cube.

Hsu: Any Cube, okay.

Page: Yeah. But, but the CIA loved it and--

Hsu: <laughs>

Page: And when was Desert Storm?

Hsu: Oh, I think it was '91--

Page: '91 or '92?

Hsu: '90-- Yeah, something like-- '92 was the election, so '91?

Page: Well, I think there was some humor about the NeXT Cubes and it was like, well, they could always drop them on-- they could always <laughs> drop NeXT Cubes on people if they want. <laughs> I don't know. But the CIA really-- the CIA really loved them and, you know, it was a good product for them.

Hsu: Right.

Page: But it's funny how the-- I mean, the main reason for doing that product was, you know, was the full color and the 3D graphics. But the feature that really, I think, sold it was the video in a window, yeah.

Hsu: Right, yeah.

Page: And that was done in hardware. And so what happened was there was some hardware to support copying the bits, expanding them out and putting them in a little hardware window, right. And you could move the window around, but, yeah. I mean, today we don't think anything about, we could have video in windows all over the screen, but.

Hsu: Right.

Page: You know, that was 30 years ago, yeah.

Hsu: Yeah.

Page: Yeah.

<laughter>

Hsu: So, I guess we were talking about the NeXTstations.

Page: Yes. Let's go back to Apple real quick.

Hsu: Okay.

Page: Back in, you know, 35-40 years ago, you know, people had data sheets and data books and stuff for semiconductors, you know.

Hsu: Yeah.

Page: They weren't online like they were in the last 10, 20 years, right. I mean, back in the seventies and the eighties, everybody had book shelves with data books on them. So one thing that was funny was if somebody came into Apple and they brought a data book with them from National, which were these sort of bright blue with yellow on them, if Steve ever saw one of those, I mean, he would explode. <laughs> He's like, "Throw that away." <laughs> Because what happened was Apple had done a keyboard chip for the Mac with National and National dropped the ball on it and about six months before the Mac went out the door we realized that National wasn't going to deliver. And we ended up, you know, taking that chip out and putting another one in, you know. And there wasn't much time, right, I mean, you know. So that this, I don't know, I guess that most of the world didn't know it, but the keyboard just barely made it in time for the Macintosh.

Hsu: Oh, wow.

Page: Yeah. It was, like, the last-- <laughs> It was, like, the last thing. Yeah, yeah.

Hsu: Wow.

Page: That was kind of funny. But yeah, sometimes suppliers,-- <laughs>

Hsu: Yeah.

Page: Yeah, do you a favor, so to a degree of sorts.

Hsu: Right.

<laughter>

Hsu: Were there any challenges developing the NeXTstations?

Page: Well, probably on the hardware side, probably the-- I mean, the printer was relatively straightforward, although there was quite a big payoff of eliminating the electronics, right. But that was kind of relatively straightforward. A lot more effort went into making the optical drive happen with Canon.

Hsu: Right.

Page: Because we did a big chunk of the electronics. And, and then the whole effort in terms of getting Ethernet into the product was a pretty big effort.

Hsu: Right.

Page: And but that worked pretty well.

Hsu: But the NeXTstations didn't have the optical drive.

Page: Oh, I'm sorry. You said-- You said NeXTstation, I was thinking Cube, yeah.

Hsu: Oh, okay. Right.

Page: Oh, NeXTstations. The NeXTstations were basically kind of a, like, a NeXT CPU board re-arranged a bit.

Hsu: I see.

Page: And from a system level, yeah, we took out the optical, kept the networking, kept the same interface to the laser printer. Yeah.

Hsu: So it was really more about simplifying the product and making it cheaper.

Page: Really simplifying the product, simplifying the packaging.

Hsu: Yeah.

Page: Eliminating the expandability.

Hsu: Right.

Page: Getting rid of the optical. Yeah.

Hsu: Right.

Page: And, you know, the optical drive wasn't super cheap, so probably the two big things that made the Cube expensive were the optical drive and the expandability. And, and so you could question should NeXT have ever gone with the optical or not. <laughs> It was-- it was nice, but expensive.

Hsu: Right.

Page: And, and should the NeXT, and should the first NeXT product have been expandable or not. You know, maybe not. <laughs> Yeah.

Hsu: And those decisions were, who had driven those decisions initially?

Page: Largely Steve.

Hsu: Largely Steve.

Page: Yeah.

Hsu: He had wanted both--

Page: Yeah.

Hsu: Both of those features.

Page: Well, he liked the idea of the fact that-- See, up to that point, you either had a floppy-based system or you had a hard drive with floppy backup.

Hsu: Right.

Page: And the floppy weren't-- the floppy drives weren't very big compared to the hard disk. So if you had, like, 10, 20 megabytes of hard disk, it took a lot of floppies to back them up.

Hsu: Yeah.

Page: And so, it was not a very good match.

Hsu: Right.

Page: And, and Steve thought, you know, the optical was kind of perfect because, you know, you could put a lot-- the first optical was 256--

Hsu: Yeah.

Page: Meg and you get, that's-- that's a lot of floppies, right. And he was, he thought that was really good. You know, it turned out to be a bit more expensive than I think he originally thought.

Hsu: Right.

Page: Yeah.

Hsu: Yeah. But the idea that you could bring everything, the entire contents of what you had in your pocket was a big selling feature for him.

Page: <laughs> I don't know where he got the shirt but, you know, he had at the announcement, he had a shirt and it had a big pocket.

Hsu: <laughs>

Page: He put the-- Because the optical drive was pretty big and he put the optical drive [disk] in his shirt pocket, you know.

<laughter>

Page: So it doesn't fit in the normal shirt pocket, right. It was kind of cute.

Hsu: But CD-ROMS came out soon, like, early nineties. So did the later products end up having CD-ROM drives?

Page: So, I don't think the NeXTstation did, I mean, not as built-in, not built-in.

Hsu: Right.

Page: I mean, you could obviously connect one on the outside, yeah.

Hsu: Right. And so were they third party drives or did NeXT make its own?

Page: Third party.

Hsu: Third party drives.

Page: Yeah. And eventually, you know, CD-ROMS gave way to CD Read/Write and--

Hsu: Right, yeah.

Page: Then eventually, DVD and DVD Read/Write and--

Hsu: Yeah.

Page: And so that whole chain of developments kind of eliminated the original optical technology. Yeah.

Hsu: Right.

Page: But I mean, the whole evolution of CD-ROM to CD Read/Write to DVD Read/Write, that was pretty viable in the market, I think, yeah.

Hsu: Right. And so the NeXTstations sold much better than the Cube.

Page: Yeah, I think so. But it was, it may have been close to half the price, right. Maybe not quite half, but, but close.

Hsu: Right.

Page: Yeah. I'm thinking that it was, you know, near $4K versus, you know, versus the Cube was closer to $8[K].

Hsu: Right.

Page: So that maybe it wasn't exactly a factor of two, but it was in the ballpark.

Hsu: It was close, yeah. But was it doing well enough that-- it still seemed like it wasn't selling enough to keep the company-- to make the company really largely successful?

Page: Yeah, I-- So I think that-- so there was one other small problem. <laughs> And maybe something you want to ask Dan'l about, because I sort of wasn't in the middle of it that much. But there were a few discussions/arguments about should NeXT go get Microsoft Office and put it on the NeXT product? And the problem if you do that is it kind of prevents third-- it doesn't prevent them but it discourages third party apps from doing things on the product.

Hsu: Okay.

Page: So, I know Steve didn't want to go after Office because I think he felt it was going to hurt third parties.

Hsu: Right.

Page: But what's interesting is a few years later when Steve went back to Apple, one of the first things he did was he brought Microsoft Office on to the Macintosh, right.

Hsu: Right. Well, kept-- kept it on the Macintosh. It was already there.

Page: Was it really there already?

Hsu: It was already there.

Page: Okay.

Hsu: It had been there for--

Page: Oh, he got it-- Or suddenly it got--

Hsu: He just-- he just--

Page: Or suddenly it got promoted with--

Hsu: Well, he just made sure that they committed to keeping it on there.

Page: Yeah, yeah. So, so one big difference between, you know, the product at NeXT and the product back at Apple was after he's back at Apple, he's got the computer plus Office, right. And, and the problem is for a lot of people, unless you have Office at that point, they got kind of frustrated, right. Yeah. Even if you have something that's kind of equivalent--

Hsu: Right.

Page: They really want Excel and Word and <laughs> yeah.

Hsu: So it was a, so you feel like a lot of it was a software issue. There wasn't enough software?

Page: Well, I mean, some customers were willing to go it alone and go with the equivalent things on the NeXT but some wanted Office and were kind of holding out for that.

Hsu: Right. Yeah. But I mean, it--

Page: So that would be a good question for Dan'l. <laughs>

Hsu: That's a good one. Yeah, that's a good one. I also heard that, though, that Bill Gates kind of publicly said that they weren't interested in developing for the NeXT anyway.

Page: Okay.

<laughter>

Page: That might have been an issue too, yeah.

Hsu: Yeah. But I think, I don't know if-- I do think that Dan'l did tell us a story about how they went up to Microsoft to see if they would try--

Page: If they could--

Hsu: They would get interest and it doesn't sound like the meeting was very--

Page: Was too successful.

Hsu: Successful, yeah, like-- <laughs>

Page: Okay. So maybe it came down to it just wasn't enough volume, yeah. Yeah. Yeah.

Hsu: Right, yeah. So you mentioned the RISC workstation. At what point did the company decide that you needed to do a RISC workstation? Why was that--

Page: So,--

Hsu: A good place to go?

Page: So, well, after the Cube and after the NeXTstation and color NeXTstation, those were a little faster than the original Cube. But you know, every year customers still want higher performance.

Hsu: Yeah.

Page: And it seemed like the 68000 wasn't quite fast enough. And, and so we actually did two <laughs> RISC workstations inside. I guess neither saw the light of day. The first one was an 88000-based Motorola version.

Hsu: Okay.

Page: And, and then the second one was a PowerPC-based one. And, and that second one I think was close to shipping.

Hsu: Oh, I see.

Page: Now at some point in all of this evolution, at some point, the hardware portion-- So two things happened. At the end of '92, I end up leaving. <laughs> And, and then a little bit after that, Canon picks up the hardware division. And, and I'm thinking then after Canon picked it up that they shipped the RISCs workstation for a while.

Hsu: Really?

Page: I think they did, yeah.

Hsu: Because I've never--

Page: Under their brand name.

Hsu: Oh, really.

Page: Like FirePower. Yeah.

Hsu: But it ran the NeXT operating system?

Page: I think so.

Hsu: I have never--

Page: Or maybe it just ran UNIX.

Hsu: I have-- Oh, okay.

Page: Yeah.

Hsu: It was, so it just became a generic UNIX.

Page: I think-- I don't-- I don't know. We could--

Hsu: Because I have never heard this before.

Page: Yeah. I think we'd have to dig into that.

Hsu: Yeah.

Page: What was funny was I went over and talked with Canon about-- at the point where I left NeXT, shortly after that, just a few weeks later, the Canon guys wanted to talk to me and I realized they were

picking up the hardware division. And, and so I went over there and talked with them and the conclusion was I didn't join them. But I guess it almost happened. But the main reason it didn't happen was I guess I was 41 or 42 at that point and when I went over and talked to the senior management at Canon, most of the Canon guys were 58, 59, 60, 61, 62. So they were, like, 20 years older than me. So, when they realized that, you know, I was 20 years younger than them, and the age of their sons, it kind of slowed them down and they were like, "Oh. He's not our generation, he's the next generation, right." And that kind of freaked them out a little bit. So, I don't know that it was the right decision, but they picked one of the Canon execs and had him run the, <laughs> you know, the company, yeah. And I went off and did my own company at that point. Yeah.

Hsu: So then, you mentioned that, you know, the second version of the workstation went with PowerPC. Was, was that because Motorola had committed to the PowerPC? They had gotten in with Apple and, yeah?

Page: There was that and the fact that PowerPC was going to be built by both Motorola and IBM.

Hsu: Right. So there would be two--

Page: It just seemed like a better vehicle, yeah.

Hsu: Right. Yeah. And so, I mean, was there any trepidation because Apple was involved in that?

Page: I don't think so.

Hsu: No. Okay.

Page: Yeah.

Hsu: What sorts of specs and features was the RISC workstation going to have? Was it going to be similar to the NeXTstation products? Or were there any-- What was--

Page: Yeah, I think basically just similar except more memory and substantially more performance.

Hsu: Okay. So just faster.

Page: Just faster, yeah.

Hsu: I see.

Page: And, you know, it probably drifted more off to a server market and less of a--

Hsu: Oh.

Page: You know, I mean, it didn't have to be. But if it was going to be faster and more memory, it's going to be a little higher price and it's going to fit better into either high-end workstation or server market and less a pure desktop.

Hsu: Oh.

Page: I think if we think back on the pricing problem, I think if you're going to put it on the desktop, it's got to be less than $4K. <laughs>

Hsu: Right.

Page: And you start going north of $5 and you get up around $6 or $7 and I think the market starts to, as we've proven a couple of times now,--

Hsu: Right.

Page: The market kind of tapers off.

Hsu: So it was intended to be a server product or--?

Page: Well, I'm not sure that that got-- I'm not sure that got completely sorted out. And I wasn't-- I wasn't, you know, I didn't see it to the end, so.

Hsu: Right.

Page: You know.

Hsu: So it was sort of developed as a desktop product but you think that ultimately it would have--

Page: But I think that ultimately it was probably more of a high-end workstation or a low-end server.

Hsu: So it would have been sort of the high end of the line and the old 68K models would still have been in--

Page: Yeah. I'm not sure that it was completely thought out, right. Or maybe what you'd have to do is have two versions of it and maybe you'd have to have like a lower end version of it that's stripped down and the lowest possible price point, right.

Hsu: Right.

Page: Yeah. But, you know, you're still trying to sit and right, I think you're still sitting right on the edge of a price that is acceptable, right. So it comes down to, you know, how do you sell it and distribute it and how much markup do you need and, <laughs> yeah.

Hsu: Yeah. So when did that project start and when was it intended to ship?

Page: So I think it started late '91.

Hsu: Late '91.

Page: And, and I think the plan was to ship it late '92-'93 and, and what happened to me was most of the other founders had left by that point. <laughs>

Hsu: Right. Yeah.

Page: And, and maybe I had sort of a midlife crisis.

<laughter>

Page: Of, like, you know, why am I here?

Hsu: Were you the only one left at that point from the founders?

Page: Yeah. And I think it was, I was starting to feel like, you know, I'd been with Steve for 14 years and now's the-- you know, now's the time for me to just to do my own company. I mean, I could have waited a year or two or three and done my own company, but it just felt like it was time to do one, yeah. And so, I kind of, I got to the end of '92 and I kind of decided, okay, I'm going to go do my own.

Hsu: Right.

Page: Yeah.

Hsu: I see.

Page: And because, you know, I, when I joined Apple it was already a little over two-years-old. I mean, I joined NeXT at day zero or day minus 50 or something, but <laughs> but it was really Steve's company, you know, and I kind of decided I wanted to do my own, you know.

Hsu: So, so had you been involved in the decision to port NeXTSTEP to Intel or to, you know, to stop doing the hardware? Or what was--

Page: Not so much. That happened about-- that happened around the time I was leaving.

Hsu: Okay.

Page: And, you know,--

Hsu: So you weren't involved in that.

Page: Not so much, yeah.

Hsu: Yeah. But what was your perspective on that?

Page: I mean, I think it-- I think it probably didn't help the NeXT hardware.

<laughter>

Page: But it probably helped NeXT as a company and it probably helped promote the software, because it put NeXT software on more machines, right.

Hsu: Right.

Page: But, you know, I kind of understood, you know, it was probably the right thing for the company.

Hsu: Right.

Page: Although maybe not the right thing for getting more NeXT systems out the door.

Hsu: Right.

Page: Yeah, so.

Hsu: Yeah.

Page: So NeXT kind of made the slow transition to software only.

Hsu: Right.

Page: And then it kind of sped up once Canon decided to pick up the hardware division.

Hsu: Right.

Page: Yeah. And I guess maybe my leaving accelerated that.

Hsu: Okay.

Page: Yeah.

Hsu: So your decision to leave wasn't because of that decision?

Page: Not so much because of that. It was more because I got to the point where I decided, you know, I'm in my early forties. It's time for me to do my own thing.

Hsu: Okay.

Page: Yeah.

Hsu: So that, that-- your decision may have precipitated--

Page: It might have. I mean, yeah, the two kind of happened--

Hsu: Pretty close.

Page: It was, the question which was-- which was-- which caused which, I don't know.

Hsu: <laughs>

Page: You know.

Hsu: Right. I mean, given that, you know, what was your reaction to, you know, all the other founders leaving over the-- You know, like, I think Dan'l was the first to leave, right? And that had been in '90 and then Susan in '91, Bud in June, '92.

Page: Well, I kind of understood. I mean, <laughs> I mean, Steve wasn't the-- Steve wasn't the easiest person to work with, right. And so when we had lunch, did I tell you about Marcel Gani from Cypress?

Hsu: I don't remember.

Page: Well, I'll tell it. I'll tell you and you can decide to keep it or cut it at some point. But I think it relates to this. So, you know, Susan left and we needed a CFO and somehow Steve found Marcel Gani and Marcel was over at Cypress. And someday, I guess I got to go dig through *San Jose Mercury* newspapers, microfiche or something <laughs> and see if I can find an article. But there was an article in the mid-eighties and it was titled something like, "The Three Worst CEOs in Silicon Valley."

Hsu: <laughs>

Page: And it wasn't worst in terms of performance, it was worst in terms of behavior. And the three, of course, were Steve, T.J. Rodgers and Larry Ellison. And I don't know if it was the three worst or the five worst, but the top three were Steve, T.J. and Larry. And so Marcel was over at Cypress and he'd been working for T.J. for a long time and somehow Steve found Marcel and he got to the point where he wanted to hire Marcel and I talked with Marcel a couple times. And then it got to be late that year and so this, I think it was-- Susan left in '90 or '91?

Hsu: I think I have it written, in '91.

Page: Okay. So she had left and so I guess late '91, we were trying to recruit Marcel. And so the very last time he came over to NeXT was it turned out it was the morning of Christmas Eve and he and I spent a couple hours and he mainly came over that day because he wanted to talk to me about how's it working for Steve. And so we talked and I tried to fill him in the best I could. And I'm not sure that he understood because, you know, he was working for T.J. and T.J. was pretty difficult. And I think I got the impression that maybe he thought well, you know, everybody thinks Steve's really bad but they don't understand how bad T.J. is. <laughs> And I got a sense that he thought, you know, T.J. was equally difficult as Steve. And he might-- maybe he was pretty close. But, you know, about six weeks after he-- So he joins in early January and about six weeks later he and I are talking and one day he's pretending to be upset with me. And he says something like, "You didn't tell me how bad Steve was." <laughs> And I remember saying, "I tried. Maybe you weren't listening."

<laughter>

Page: And so I realized through all that, it's one thing to describe to somebody what somebody's personality is like but it's another thing to describe the magnitude, right.

Hsu: Yeah.

Page: You say Steve's aggressive, well, how do you explain the mag-- It's hard-- It's easy to say, well, you know, he's got these characteristics of behavior, but how do you describe the magnitude. And the only way to do it, I think, is to compare him to somebody else the two of you know in common, right.

Hsu: Yeah.

Page: But unless you have some common person you can say, "Well, he's just like that person except worse" or something, it's hard, right.

Hsu: <laughs>

Page: And so, I don't think Marcel was really upset with me, I think he was just pretending, you know, because he-- You know, he had, at this point he had bumped into Steve a few times and kind of like the five-year-old, burned his hand on the stove and, like, "Oh, okay. I don't do that again."

<laughter>

Page: So, yeah. I don't know. I think that, you know, it took a lot of energy to work with Steve. And I think that it just kind of after some number of years it wore thin, right, and for different people it's just some were shorter, some were longer, right. You know, Dan'l was at Apple for a couple years and then at NeXT for five years or whatever it was. And, you know, so he'd been around Steve for, like, I don't know, eight

years or something. But I guess he got to, he had reached his limit, right, and the same thing with Susan and each of them, you know. <laughs>

Hsu: Do you think it had to do with any of, I mean, differences in opinions about the direction of the company or decisions that had been made that they might have disagreed with?

Page: I don't think so. Well, maybe a little, but I think more it's just the wear and tear. <laughs> The emotional wear and tear, yeah.

Hsu: Yeah.

Page: Because for me, kind of for me, I think two things happened. One was I wanted to start my own company. And the other thing was after having done that for 14 years, I was feeling kind of tired, <laughs> a little worn out. I was like, I think it's time I'm on my own, yeah.

Hsu: Right. <laughs>

Page: I mean, could I have continued? Yeah, but. At some point, the grass looks greener <laughs> over there.

Hsu: Right. <laughs> But was it an amicable departure?

Page: Yeah, I think so. So, you asked about the relationship with IBM. Do your notes also have the relationship with HP?

Hsu: Oh. There was one later on, right, that was more enterprise focused?

Page: I think there was one in, like, 1990 or '91 and--

Hsu: And was that actual hardware?

Page: No, it was around NeXTSTEP.

Hsu: It was around NeXTSTEP, right, it was--

Page: Maybe it was '91 or early '92.

Hsu: Yeah.

Page: Because what I remember was that it was after most of the founders left.

Hsu: Okay.

Page: And the reason I remember this is and Marcel was there and I was there but there weren't-- none of the other founders were there.

Hsu: Right.

Page: And I remember one day, we come into the Tuesday staff meeting and Steve was upset. And Steve had read the *San Jose Mercury* that morning and I had already seen it and I was like, "Oh, shit. <laughs> This is not going to be a good day." <laughs> And there was an article in the *San Jose Mercury* and it kind of preannounced the deal between NeXT and HP but Steve wasn't ready to announce it yet, but it kind of leaked out through the *Mercury*. And Steve comes into the staff meeting and he's fuming. <laughs> And so he's yelling at Marcel and I and Gary and he's upset, "How come this got out?" Right. And I sort of sheepishly said, "Steve." I don't know how I should've handled this. But I said, "Steve, if you read the article carefully, you see that it's not us. Because it says, 'four VPs from the company confirmed.....' We don't have four VPs."

<laughter>

Page: "It wasn't us. <laughs> It wasn't Marcel and I." <laughs> It was just the two of us.

<laughter>

Page: So, I think Bud had just left, otherwise there would have been three of us, right, but--

Hsu: Right.

Page: I think Bud had just left and there was just Marcel and I and, yeah, and, you know,-- But he-- I'm not sure that made him feel any better, right.

Hsu: Right.

Page: The fact that I explained to him that it wasn't NeXT and it had leaked out through HP, he was still frustrated.

Hsu: So it was HP that leaked it.

Page: Yeah.

Hsu: Yeah.

Page: Whether they did it intentionally, probably not. But, you know, sometimes reporters are really good at making phone calls and getting information out of people. Yeah.

Hsu: Yeah. <laughs>

Page: I think we've all experienced that. <laughs>

Hsu: Right. So were you involved in that deal at all?

Page: Not really. But I guess indirectly through sort of collateral damage, right?

Hsu: <laughs>

Page: Getting yelled at. <laughs>

Hsu: Right.

<laughter>

Hsu: So did you and Steve remain in contact after you left?

Page: Some. Not so much. The whole time I knew Steve, it was like you're either part of the company and you're part of that world or you're not.

Hsu: Right.

Page: And once you're outside the company, you almost don't exist.

<laughter>

Page: So it was a pretty-- a pretty bright line, because Steve was pretty focused on, you know, on the company; whether it be NeXT or Apple, you're either inside that triangle or you're out, and if you're out, you're out. <laughs> I mean, I saw him a couple times, but not too much. Yeah.

Hsu: Right. So what was your-- What's your assessment of Steve as the CEO of NeXT and had he changed or had he not changed since you knew him at Apple?

Page: Well, a lot of people asked me the question after they joined NeXT and they'd been there for a period of time, a lot of people came and asked me, "Has he always been like this?" Because, you know, he seemed pretty aggressive and pretty, you know. And typically, my answer was, "He's much better now." <laughs> "He used to be really bad, but, you know." Because I, at this point I had already been around him for, like, eight years or so and from when he was, like, 23 or 24 to, like, you know, 30, 31, 32, he had mellowed. I mean, he was still pretty, still very aggressive, but compared to the way he behaved when he was 24, he was softer. But for someone new to the equation and never seen him when he was 24, they can't imagine it being worse, right. And you tell them he's much better and they don't-- they have a hard time understanding, right.

Hsu: Right.

Page: Yeah. So, I think, you know, people, not just with him but I've seen it with others, where people sort of slowly temper, right, yeah. And I mean, his user interface wasn't the best.

Hsu: Right. <laughs>

Page: But kind of hard to fault the success, right. Because I think whether it was the first time at Apple or at NeXT or his second time at Apple, I think you take someone else out and put him in to run the organization and I think people get more done, you know, with him in charge. Now is it because he's more aggressive and, you know, he yells at people more and <laughs> maybe it's a bit more of the stick than the carrot, but, you know. I mean, just, I don't know, he's just more demanding, I guess. Higher standards, yeah.

Hsu: What do you think, what mistakes do you think he made at NeXT?

Page: Well, I don't know if there was a way that the product could have been cheaper, but I think well, maybe the biggest problem was the product ended up being too expensive. And how much did we miss it by? Maybe we missed it by 50 percent. I mean, had it been $5K instead of close to $8, would that have changed the outcome significantly? Maybe. You know, and so maybe the biggest problem was it was too expensive, right. And so had the first product not had the optical and not been expandable, maybe that would have been enough to-- if we'd done the-- if we'd done something close to the NeXTstation as the first product, that might have been enough to make it happen. But, you know, on the other hand, it's hard to get a new computer system off the ground, right. And so, one thing I've thought about a few times is, you know, maybe we should never have left Apple, right. <laughs> You know, maybe instead of Steve leaving Apple, maybe Steve should have just started something inside Apple, right. You know, I mean, that might have been possible. But I don't know, maybe he didn't think it was because he kind of got pushed aside.

Hsu: Right.

Page: Yeah. But we didn't really intend to do a Macintosh but one thing we could have done is we could have done something that was Mac-compatible. That might have really upset Apple, but we could have done something that was Mac-compatible and that probably would have been easier <laughs> and maybe had a bigger market for it, right, but not as unique, right. So, I don't know. It would have been nice if the product was cheaper, right, because that would have-- there would have been more volume.

Hsu: Right.

Page: And it would have been easier to sell. A lot easier to sell something for $3995 than it is for $7500. <laughs>

Hsu: Right.

<laughter>

Page: Yeah.

Hsu: What do you think he did well at NeXT?

Page: Well, one thing you can look at is there were, like, 5-600-- people and you can-- there are a lot of those 500 people that went off and did fairly successful things after that. I mean, and so I think he, you know, he did a really good job of putting the team together and help recruit, you know, a couple hundred really good people. And maybe the-- maybe NeXT wasn't as successful as it might have been, but a lot of those people, you know, ended up going on and doing things, right. Some of them ended up-- some of them ended up staying with him and going back to Apple. But a lot of them went out on their own and did things, right, so. The last few years I've been, you know, working with small companies and doing some investing in things and one thing that I heard recently that surprised me, but it's related to this, is a lot of investors don't want to invest in a company that has a single co-founder.

Hsu: Right.

Page: I mean, a single founder. They want to have at least two or three co-founders. If you have a single founder, it's a problem because the job of getting a company off the ground is really more than what one person can do. And if you have only one founder and he's got to cover the product and the customer and he's got to raise money, that's more than what most people can do. And so, I didn't realize it until the last five years but I thought back on it and realized when we founded NeXT, we had Steve plus the five of us and we had pretty much everything covered, right. We had software, we had hardware, you know, finance, marketing, you know. Todd joined pretty quickly, you know. So, we had most everything covered pretty quickly. And--

Hsu: Todd?

Page: Todd Rulon-Miller.

Hsu: Who was in-- Who was the--?

Page: Yeah, VP of Sales.

Hsu: Sales, okay.

Page: Yeah. And I think Steve really believed that you hire the best person you can to run a function and then they need to hire and build out the team. Now, I guess you can jokingly say that he's got one person he can yell at, right.

<laughter>

Page: Whether you're in marketing, sales or hardware or software, there's one point person he can go after. <laughs> But one thing I've noticed is if you build a team down from the top and you hire

underneath that person, that tends to work better. If you hire-- If you don't have that person and you hire somebody in who's more junior and then you later try to hire somebody in above them, sometimes it works and sometimes it doesn't. Because sometimes that person feels like they've gotten demoted and even though maybe the CEO told the person, "Well, we're going to hire a VP in above you at some point," they forget. <laughs>

Hsu: Right.

Page: And so it's better if you can hire the senior person first and then hire below them. And so Steve was pretty good at, you know, building the organization, I think.

Hsu: Right.

Page: And I think the fact that the 300, 400 or 500 people went off and accomplished as much as they did I think is-- it reflects on him, too, you know.

Hsu: How do you think he learned from his mistakes?

Page: I don't know. That's a tough one. Occasionally, I wondered, sometimes he, when he was getting too aggressive with people, you know, sometimes he'd go too far and I wondered from time to time, did he understand it? And I think the answer was no, I don't-- I think sometimes he went too far with people and he didn't-- he couldn't see that he'd gone too far with them. And you'd have to tell him. You'd have to say, you'd have to kind of pull him aside and say, "You keep going where you're going this afternoon and he's not going to be back tomorrow." <laughs> And Steve would look at you like, "What? <laughs> Are they really that thin-skinned?" And I'm like, "Yeah."

<laughter>

Page: But so I think sometimes he would go too far with people and he wouldn't realize it. Maybe other times he did. And sometimes he'd back off. But, you know, he, I don't know, he liked being aggressive with people and but not everybody can put up with that for an extended period of time, you know. But, but I think about the teams of people that worked for him, and they seemed to get more done with him around than with someone else, right. You know, it's just the way it was.

Hsu: Could you talk about how you felt when he passed away in 2011?

Page: Well, I hadn't-- I guess I, you know, I was sad. <laughs> But I hadn't seen him in a while and I guess I-- I guess I regretted kind of, like, not making an effort to, in that last year or two, go see him. Yeah. So, unfortunate, yeah.

Hsu: Okay. So let's talk about your startup.

Page: So I did two after NeXT. So, first I'll tell you the name of the two companies and you'll get a kick out of this, I hope.

Hsu: <laughs>

Page: So the first one was called Sierra Research and Technology. And then the second one, I came up with this creative name of Next Sierra.

<laughter>

Page: So I had the first one and I sold it and then I had to come up with another one, so I decided, "Hmm, Next Sierra."

<laughter>

Page: So everybody laughed at that. So, so we roll the clock back to '87 or so, '86. And I told you, we, one of the things we did with the NeXT product is we did the 10 megabit Ethernet.

Hsu: Yeah.

Page: And one of the things that happened in sort of that mid-eighties, was we kind of hit Ethernet at the right time. And so by the time we came out the door with the product in early '89, it was having 10 megabit Ethernet on there was a perfect match to the market. So, now we roll the clock forward a few years and I start Sierra and I said to myself, "Hmm. You know, 10 megabit Ethernet in the mid-eighties was perfect, the perfect thing to do. Now it's early '93, we're not too far away from 100 megabit Ethernet. You know, clearly what we ought to do is we ought to go do 10/100 Ethernet." And I don't know if you remember '93 or not, but at that time there was this war between ATM and Ethernet.

Hsu: Oh.

Page: And it was ATM at 155 and 100 megabit Ethernet were kind of warring at the desktop. And so a lot of companies, I guess the joke was that there were more companies doing 155 ATM than there were customers.

<laughter>

Page: I think it was hard to find a semiconductor company somewhere in the U.S. or Japan or Korea that wasn't doing 155 ATM. I mean, everybody believe[d] that ATM was going to win this war.

Hsu: Really?

Page: And, and in the early nineties, everybody was doing ATM. And it was so crowded that we looked at 155 and we said, "There's no way we can do 155 ATM." It was just everybody's doing it. So we started

a 10/100 Ethernet project, but to kind of defend ourselves we decided to do 622 ATM, because what we noticed was nobody was doing 622 yet. So we got the 622 done and working and we licensed that to Toshiba and it worked pretty well. And then right after we licensed that to them, we also licensed the 10/100 Ethernet. The fact we had done 622 helped our credibility with 100 megabit because the fact we did 622 and it worked, everybody believed, oh, well, of course they can do 100 meg.

Hsu: Yeah.

Page: And, so, we probably shouldn't have done the 622 ATM from a business point of view but it did help with our technical credibility. And we only had a few ATM customers. We had lots and lots and lots of Ethernet customers. So by '95, I think, I think this war between ATM and Ethernet was over or nearly over and I think ATM was losing and Ethernet was winning to the desktop. And for a while there, we were the only ones that could license an Ethernet design to you. So, there were a fair number of people like AMD and others that had 100 megabit chips, but if you didn't have a design and you wanted to buy one, the only place you could get one was us. <laughs> So it took us a while but we licensed it to about 40 companies worldwide.

Hsu: Oh, really?

Page: So we did really well with that.

Hsu: Right.

Page: And after a while there was some competition, but we had a pretty good lead for a while.

Hsu: Right. A lot of those were Japanese companies?

Page: A lot were Japanese but it was like every major semiconductor company in the world. It was Toshiba, Fujitsu, NEC, Mitsubishi, Hitachi, LG, Samsung, Siemens, later Infineon and Philips, you know. So most everyone would recognize at least half of the names.

Hsu: Right.

Page: There were a few names that were, you know, a little less obvious. Some second tier or third tier companies. But the first 15 or 20, everybody would recognize, yeah. So that worked pretty well.

Hsu: How did-- Let me go back. How did you decide that the company should be networking?

Page: Well, when I left NeXT and I was thinking about what we should do, you know, I thought about the 10 meg experience and I said to myself, "That worked really well." <laughs> You know, hiring a couple of engineers and putting them on 10 megabit Ethernet, I mean, it worked really well. And so, and although at NeXT we really just did the digital piece; we just did the controller and the protocol piece. At Sierra, we did the digital piece plus the analog. So we had the complete solution all the way from the bus all the way

out to the wire. And because we hit 100 megabit, we had to do twisted pair. Because the coax faded away with 10 meg, right, and so 100 meg really only existed as twisted pair. So we did our front end, so we had the analog front end and we had the protocol piece and we had the DMA piece, so we had it all the way from the bus all the way out to the wire. And so we had a complete solution. But when I started the company it kind of hit me then, this is-- the market's just 18 months away. It's coming like a freight train. <laughs> You know, if we start today, we can be there just in time, right.

Hsu: Wow.

Page: You know, yeah.

Hsu: Yeah.

Page: Yeah. So, we happened to hit, timing-wise, we happened to hit it perfectly.

Hsu: Right.

Page: Yeah. So I guess the one thing I learned from that, when companies often get off the ground, sometimes they don't have a real clear-- they think they have a clear idea what they want to do, but sometimes they don't have sufficient clarity. <laughs> And they start something and they go down one road for a while and then they kind of throw that away and then they change gears and they do something quite different. And if you do that once maybe you can survive. If you do that two or three times, I'm not sure that an average startup can survive.

Hsu: Right.

Page: Yeah. So I think it's important to find something that you can execute as your first product that you can pretty much go straight after. Now we had this little excursion off to ATM, <laughs> which actually helped us, but that was probably a distraction. I'm not so clear we should have done it but it did help us. A comical thing that happened was since we had done the 622, right after we did the 622 we briefly considered 2.5 gig. <laughs> So we kind of decided that the 622 was interesting and everybody else was at 155, but we looked at 2488 briefly and we did the Western Digital thing of we put together a datasheet. <laughs> We didn't have a product, we just kind of put together the datasheet and we sort of circulated it a little bit. Now after a while, we kind of decided, nah, it's not worth it. But before we gave up on the idea, the NSA contacted us and they wanted to-- We were the only ones they could find at that point. This was 1997, '96. We were the only ones they could find that were talking about 2.5 gig and they wanted to know our roadmap to 10 gig and 40 gig. And I'm like, <laughs> and I went back and met with them, but I'm like, "You know, I mean, we could work on the problem, but we don't really have a roadmap for 10 gig or 40 gig." But, you know, they were, you know, they wanted to see where the future was going. But we couldn't see our way to a 2.5 gig market, so there was no way to at that point to see 10 gig or 40, yeah. Just way too early.

Hsu: And I think you had told me over lunch that you, one of your funders was a Henry--

Page: Singleton.

Hsu: Singleton. Who you'd met years earlier?

Page: So I met Henry-- I'd been at Apple for about a year and Henry had bought an Apple II down in Southern California and I don't know, 6, 8, 10 weeks later he came up to Cupertino and I guess decided to buy a big chunk of Apple. And I think he bought 14 percent and this was back well before the IPO and I think the valuation of the company was about $100 million. So I think he bought 14 percent of Apple for about $14 million dollars, but--

Hsu: Wow.

Page: We can-- You can find the number somewhere. I'm just kind of doing this by memory. So Henry was obviously an accomplished business person, <laughs> because he was fairly wealthy at this point, but he was also very technical. And so I guess he was going to the-- he got a board seat and he was going to the board meetings and he had all these questions about the product. And so one day Mike Markkula asked me if I would help Henry. And I was like, "Sure." <laughs> And so I met Henry and for a long time I was helping Henry with all his questions and things. And so we got to be good friends. And, and then we roll the clock forward to we start NeXT and then we roll the clock forward another seven years and apparently, when I finally left NeXT, there was a little tiny two paragraph article in *The Wall Street Journal* that said I had left and out of the blue I get this phone call from Henry. <laughs> And apparently, every morning, you know, he was reading the first page or two of *The Wall Street Journal* and he saw my name and so he calls me up. And he says, "Well, let me know when you're ready."

<laughter>

Page: Because I told him I was thinking about starting my own company. And so, this was, like, January of '93. And so about, oh, I don't know, a month or so later I give him a call and I go visit him down in Southern California and we work out a deal and so Henry and myself and then a friend of mine from college, we funded the company and it was the only money we ever put into Sierra. So we had one round of funding on, like, day 45 and that was it.

Hsu: How much?

Page: It was three point three total between the three of us. So, most startup companies, you know, raise some money, raise some more money, raise some more money. So, all the employees at Sierra did pretty well when we finally sold the company because the percentage they had at the beginning, they still had in 2000. So, seven years later when we sold the company, they all still have the percentage they thought they had, which was a little unusual. So, not a big surprise, but early ’99, TDK comes and visits us. And I got pretty good I think at, when I met somebody new, trying to understand whether they could be a customer or not. And there were certain things that customers would say and certain things that non-customers would say. And I could pretty quickly distinguish whether someone was a customer or not a customer. And the TDK guys came, and they were just all over the place. They had questions about

everything. And one of the big red flags to me was a typical customer was very focused on one thing because we had multiple products at that point. And usually a customer was very focused on one piece of IP. So, but they had looked at our website. And for some reason, they were just-- they had questions about everything. And so, after the meeting was over, I said to myself, "I'm never going to see these guys again." And sure enough, they disappeared. And I didn't hear from them for almost a year. So, early 2000, they come back. And on the second meeting, which was like eleven, twelve months later, I realized the reason they were interested in everything, they were actually interested in the company. They were not interested as a customer. They were interested in acquiring the company. And once I realized that, then I understood. Oh okay, now I understand why so many questions. So, it took them a while. I mean you have to remember they were Japanese. It took them about five months or so before we put a term sheet together. And then it took another five or so months to get from there to finishing the acquisition. But we wrapped it up before Christmas. So, we started the whole process in early February or something, and we finished it in December, so about ten months. That's a while, but not too bad for a Japanese company.

Hsu: First, why were they interested in acquiring you? And second, why were you interested in selling?

Page: Well, I think they were interested because one of TDK's successful products was they were doing PCMCIA cards. And they were a big supplier of Ethernet cards to the market. And back in the late '90s, most laptops had PCMCIA slots. And most laptops, the way you got Ethernet into your laptop was you bought a card, slipped it in, plugged into your cable. Because I don't think in the mid to late '90s that anybody had built-in Ethernet in a laptop. So, they wanted to expand what they were doing in networking. And they had about thirty, thirty-five engineers. And Sierra was about that size. We had about thirty-five. And they viewed this as a way to double their efforts. So, that was their motivation. My motivation was, if I thought back over my career, all of my transitions seemed to, either by plan or by accident, seemed to happen around about the time of recessions. I started at Fairchild in '72-'73 when we were in the middle of the oil crisis, the real small one in '79, when I went to Apple. There was a little crash in the computer industry in '85, when we started NeXT, a real modest recession in '92-'93 when I started Sierra. So, the nice run we had in the '90s, I felt like it was starting to come to its end in 2000. And I said to myself, "I could stick with this for a few years and ride the world down and back up. Or I could let go of this, and I could get out." And TDK happened to come along, and so we worked things out. And I decided it was time to get out. I had some friends down in southern California that had a company. And they got an offer that was actually pretty big. They had an offer that was over a hundred million dollars for the company. And it was a little bit larger than mine. But I guess they had it in-- either they or their board had it in their mind that the company was worth like two hundred fifty or three hundred million. And they had an offer for more than a hundred. And they turned it down. And by I guess the end of 2001, they were out of business. So, they did the opposite of what I did. They decided-- they had an offer. They decided to turn it down. But the market killed them because-- I guess maybe the market went down farther and faster than everybody expected in 2001.

Hsu: Yeah.

Page: So, we roll the clock forward to 2003. And surprise, surprise, TDK, when they acquired us, was like two hundred and fifty, maybe close to three hundred people down in Irvine in Southern California. I mean they had many more people in Japan, but their semiconductor group in Southern California was in Irvine. And it was like two hundred and fifty, two hundred and seventy-five people. Because of the 2001 downturn, they had a number of layoffs. And they progressively got smaller and smaller and smaller. And eventually, the engineers that were there from Sierra, they eventually got laid off. And end of 2002, early 2003, some of them were like knocking on my door and asking me, "Well, Rich, when are you going to do something? How about if you do something sooner rather than later?" So, I did. And I guess it was a good time to start a company because it was early-- I guess it was early 2003. And rents were really cheap. We got like nine months' worth of free rent. And even after that, the rent was pretty low. And it was a good time to start something.

Hsu: What had you been doing in the couple years before, in between--

Page: Well, the first eighteen months or so, or first fifteen months, I stayed with TDK as a consultant--

Hsu: Oh, okay.

Page: And kind of helped them, but at some point trying to separate with them. And then I didn't do too much for about six months or nine months in sort of 2002. And then we got Next Sierra off the ground. And this time around-- I guess I should back up. When we had Sierra, we were mostly networking. But we got to the point where we decided that we wanted to do some of our own products. Now, I had promised a number of our customers we weren't going to do Ethernet chip products as a product. In other words, we're going to sell IP, but companies like Toshiba must have asked me ten times, "You're not going to compete with us, are you?" They were afraid that we were going to go make chips and compete with them. And I kind of promised them, "No, we're not going to do that." So, we got to the point where we decided we wanted to do some of our own chips. And what we ended up doing was we ended up doing some display drivers. And in the late '90s, there were these polymer OLEDs as a precursor to sort of organic LEDs, OLEDs. And I don't know if you remember, but there was a Motorola flip phone that had the poly LEDs for the display. So, we had done the display driver for that. And we actually did that chip and sold it through into Motorola through Philips. We were working with Philips, and that was pretty successful. So, and we did a couple of other projects with Philips. So, when I started Next Sierra, I kind of said well, that worked. Maybe we could go in that space and develop some chips in that space. It was a bit harder than I expected. But our sort of our flagship product, if you like, was an active matrix OLED driver. And we sold that to a few people. But I think the big problem was it was 2005-6-7, and OLEDs weren't really on the market yet. Apple just now in the last couple years putting OLED in their phones. Samsung has been doing it for, what, five, six years, seven years something? So, maybe Samsung started doing it in 2010 or '11. But we had this driver, and we were working on this back in '05-6-7. And I think we were a couple years too early. So, we bumped into a company. So, there were a couple of companies in this space. One is Universal Display Corp back on the East Coast. And the other one is Cambridge Display Technology. And Cambridge Display is a U.S. company, at that point, of one or two people with a subsidiary over in Cambridge, U.K. with a couple hundred people there. It took a little while, not too long, but they ended up acquiring us. So, I met their CEO in early October of '07, and we had a

handful of meetings between early October and Christmas. And we managed to get the deal done before Christmas. So, where the TDK one took like ten months, this one took like ten weeks.

Hsu: Oh, wow.

Page: Or less, eight weeks maybe. So, I-- after-- so, going back to the recession problem, when Rich sells his company, maybe you want to run for the hills. So, I sell my company at the end of ’07. And then you know how ’08, ’09 played out.

Hsu: Right. Are you just really good at somehow predicting these things, or it just works out--

Page: I think it was partly a gut feel but mostly accidental, yeah. But-- maybe just mostly coincidence. So, after the-- after things started to turn around in ’09, I actually ended up at Rambus in the fall of 2010. I’d worked with a couple other companies as a consultant for a year and a half or so. And I had some friends at Rambus. And I ended up working there for a few years, became their second fellow. And eventually, it didn’t work out because I sort of view myself as a product guy. And Rambus is a patent company. And they’re great at doing patents. And they’re great at monetizing patents. They kind of want to do products, but they’re not really a product company. I think it’s like not in their DNA. And they may not like that description, but that’s kind of how I feel. And so, I left at the end of ’14. And I started hooking up with a couple of very small startups, and typically, first or second investor, joined the board and helping them. And so, in the last few years, I’ve been active with three or four companies at any one point in time. And I generally spend a day or two a week with each one, some a little less, some a little more. So, that’s been working out. So, one thing I noticed, thinking back on my career, when I was at HP, it was like seventy thousand people. Now, HP today is, what, three hundred fifty thousand? But anyway, back then, it was like seventy thousand. And I went to Apple. Apple was pretty small, but when we left in ’85, I think it was like seven thousand or six thousand or something. And then NeXT grew up to be like six hundred people. And then since then, I had my two companies, which were both much less than a hundred. And then since then, I’ve been working with companies that are ten, fifteen, twenty, thirty people. So, I somehow drifted into this size of a few tens of people. So, I don’t know. It’s fun. I like it.

Hsu: Well, how would you maybe summarize your career so far?

Page: I guess I’m-- I guess one mistake I made was, after Steve went back to Apple, I should have probably found some way to get back into Apple. Not going back and-- that was probably a major mistake financially.

Hsu: Yeah.

Page: Oh, well. But the rest of it, I’m pretty happy with.

Hsu: Yeah, a number of NeXT people went back, right?

Page: Yeah.

Hsu: Bud's back there.

Page: Bud went back. I had hired John Rubinstein in from HP.

Hsu: Right.

Page: Into the hardware team. And he went back, and he was running desktops for a while and then iPod and iPhone and then eventually went to Palm.

Hsu: Yeah.

Page: Yeah so, he did quite well.

Hsu: Yeah.

Page: Yeah so, there were a lot of-- I mean there were a lot of people that were part of NeXT that each one did well on their own. Yeah, Mark Ross was not real early in the team but probably in the first twenty or thirty engineers that I hired. And Mark was probably one of the best on the hardware team. And he eventually ended up over at Cypress and was the CTO working for T.J. for a number of years. And I guess he lasted for like four years or so. Then I guess he decided he had enough. But I was impressed. But there were a lot of people at NeXT that just went off and did something somewhere. An interesting thing, so all the companies I'm working with right now, they're all in the Valley, either because I helped them move here, or they started here. So, like two or three of them were here. And two I helped move them into the Valley. I'm working with one kind of casually out of Sweden. And so, I don't think my daughter quite understands it. But anyway, I have my thirteen-year-old. And so, she's an investor in the company in Sweden.

Hsu: Oh, your thirteen-year-old?

Page: Yeah, so yeah. So, maybe when she's a little older, she can figure out what she's gotten herself into. Yeah. That's fun.

Hsu: What particularly attracts you to working with the startups?

Page: I guess, when I was at HP, one thing I noticed was you couldn't-- there were a lot of people at HP. And one thing I noticed at HP was, if you didn't do your job, probably nobody noticed because somebody else would do your job. But if you did your job, and you did it well, maybe nobody noticed either because there are too many people. So, the too many people problem was kind of like it stopped people from recognizing who was doing a good job and who was doing not such a good job because HP just had too many people, I thought. So, I guess one thing I like about smaller companies is you're more dependent on individual performance. And so, if you do a good job, then you stand out. And if you don't do a good job, well yeah it doesn't work. But-- and not every startup makes it. But I think the ones that have a clear simple story and take a clear path from beginning to a product, I think they have a good chance. Like I

said, if a company wanders too much, that's a problem because you really can't afford to wander too many times. Maybe you can change course once. But you change course a couple times, it's-- it probably takes too long. You lose momentum, and it falls apart.

Hsu: Where do you think the industry is going? What's the next big thing?

Page: One of the things that scares me, especially since I ride the bicycle, is all of the autonomous vehicles. Yeah. I don't know that the vehicles scare me as much as the fact that maybe what scares me more is what I characterize as the twenty-five-year-old software engineer. <laughs> What if they get it working, but then six months later, what if they make some major change, and they take two steps back, and they do a software release overnight, and all of a sudden, the cars tomorrow morning don't work as well as they did today. It makes me a little nervous. Maybe it's not quite as bad as it sounds, but-- I have to say it really isn't Waymo and some of those that concern me because I think-- although there may be Waymo causes congestion in Mountain View. It seems fairly robust. But there are a lot of companies that maybe don't have the same scale as Google had with Waymo and don't have the same level of testing and effort. And so, maybe the top few companies don't scare me as much as what about companies number eight, nine, and ten because if you have too little testing and you turn it loose on the road, it kind of scares me a bit. So, along those lines, I think back to when I was a teenager. And my dad must have told me over and over, "When you buy a car, make sure it has a manual transmission <laughs>, nothing electrical <laughs>, nothing automatic." He was against automatic transmission, automatic steering. He was like-- he wants it to be really simple, so you can fix it because back in the '50s and '60s, cars were not the most reliable thing, and a lot harder to fix a car if it's got an automatic transmission than if it's got a manual in it. And so, and his point was you want a really simple car, so you can fix it. And you don't want to trust the car companies. And I think back on that, and you think about where cars have come in the last forty years, fifty years. They've come a long ways. But now we're coming from cars that work pretty well to autonomous vehicles, right? And-- he would have been scared by the changes in the last fifteen or twenty. I mean what's happened now, <laughs> he-- yeah, it would be crazy.

Hsu: What advice do you have for a young person starting in technology today?

Page: So, when I had my first job at Fairchild, I don't know if it was really meaningful or not, but my boss's boss, I remember I met with him one day. And he said-- I remember he said, "What you want to do is don't do the same thing for too long. You can't do one thing for a year or two. But you don't want to be doing the same thing for fifteen, twenty years." In other words, you want to do something until you're really good at it. But once you get to the point where you're doing the same thing for six, seven, eight years, probably you want to switch and do something different because if you wake up one day and you've been doing the same thing for twenty years, that's probably too long. So, partly because he said that and maybe partly by accident, I started off in manufacturing. I moved into design. I was working while I was going to school, so I ended up doing system design and software and stuff at Apple and then more hardware at NeXT. And then I did a lot of stuff with chips and things. And while I was at NeXT, I got involved a little bit with sales. And I sort of learned the ropes there. And then I sort of spent most of my time managing the company and doing sales when I had my two startups. And so, kind of over my career, I sort of ended up doing a half a dozen different things all the way from manufacturing to design to sales

and marketing to managing the company and-- partly because he said that. I don't think I followed his advice, but I think back on it. I go, "Yeah." He's right because sometimes I meet people, and they're doing the same thing they were doing twenty-five years ago. And they ask me, "Well, how do I get out?" <laughs> I'm like, "Well, you just have to step out, right?" Yeah. But if you wake up one day and you're forty-five years old and you've been doing the same thing for twenty years, it's a bit harder. So, and a lot of engineers, maybe because the way the world works today, a lot of engineers don't even get involved in manufacturing anymore and-- because a lot of companies don't even have any hardware. So, maybe if you're working at a pure software company, you're probably not going to get your hands on much hardware. So, you're probably not going to get a chance to work in manufacturing. Before I went to Fairchild, I had a number of jobs, mostly minimum wage, hourly, like a buck ten an hour or something. But one of them was I was electronics technician at a company in Sunnyvale. And they were making videotape. And this was 1970. So, they were making these big rolls of Mylar videotape. They were about ten and twelve inches wide on these big rolls. And after they made them, they ran them through these slicers and split them up into like one-inch strips. And then the scary part was they recorded a signal onto these. And they had college students sitting in front of screens watching the videotape go by and counting dropouts. And so, their Q and A mechanism was to basically record a signal onto videotape, play it back, and sit there with a pencil and paper count how many dropouts there were. And I was like, "Oh, my god." But yeah, there wasn't really any technology back in 1970 to do that. But this was sort of pre-Beta, pre-VHS. This was-- their market was like one-inch videotape for broadcast TV and stuff. So, this was just before, or just as Beta was, you know, Betamax was coming into play. VHS was coming in. But that was my-- that's sort of the first technology job that I had. I was just a technician there. It was kind of fun. When I was at Fairchild, and I was mostly working in manufacturing, I don't know that Fairchild had to be as responsive or as reactive to the market as they were. But on the other hand, it was my first real job. But Fairchild, as an organization, was trying to get through that recession. And as things would turn around, they would hire a few more people. But into the recession, when it turned down, they'd let a few people go. And it was like, over that year and a half, two years, it was like a roller coaster. They were hiring people. They were firing people. I thought it was a little crazy. And my introduction to design was I ended up fixing up some chips that-- where the designer had gotten laid off. And the design manager was like, "Well, we don't have him anymore. Do you want to go fix it?" So, that was my-- the first chips I worked on. But to give you a sense of scale, in '72, '73, Intel and Fairchild had 1k bit dynamic memories that sold for ninety-nine dollars. It wasn't clear to me that all 1024 bits worked, but they mostly worked. But it was 1024 bits for ninety-nine bucks, so just under nine cents a bit or thereabouts. So, yeah, the world has come down considerably. Apparently, there was a 256-bit DRAM that was the precursor to that one. And I guess that was before I was at Fairchild. And I guess that must have been in '69 or '70. And for some reason, the 256-bit DRAM failed. And it wasn't until the 1k DRAM hit the market that that one displaced core memory. So, I don't know if it was a cost per bit issue or what. But the 1k bit dynamic memory displaced core in the '72, '73, '74 timeframe. And then from there, 1974 or '5, we had the 4k, and then 16k. I don't know. Yeah, so.

Hsu: All right.

Page: All right.

Hsu: Thank you very much.

Page: Okay.

END OF THE INTERVIEW

