Oral History of David Liddle

Interviewed by:
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Hsu: Okay, the date is February 4th, 2020. I am Hansen Hsu, joining me is Doug Fairbairn and we are interviewing David Liddle. So to start with, could you tell us when and where you were born?

Liddle: I was born in Detroit, Michigan on January 9th, 1945.

Hsu: And where did you grow up?

Liddle: Grew up in Detroit and then went to school in Ann Arbor and then finally in Toledo is where I got my PhD, that being the only place in the Midwest where you get a PhD at night and work all day.

<laughter>

Hsu: Could you tell us about your parents' backgrounds?

Liddle: Sure. My father had also gone to Michigan. He was an engineer and he had a rep company selling electronic components, so from a very early age I could make a little money sorting resistors and stuff like that. I built a tube-based radio and so on. My dad was somebody who just didn't believe in repairmen. If anything broke, he was just going to fix it. And so that generally caused me to drift in the direction of engineering. My mother wasn't really a professional person. She did a great deal of pro bono activities for non-profits and things like that. So she had a lot of community and sort of public exposure and she was named by Governor Romney, the earlier Romney, to a statewide blue ribbon panel and so on, so that was my mother.

Hsu: Any siblings?

Liddle: Yeah, I have an older brother. He still lives in Michigan part of the year and in Florida the rest of the year. He went into the printing business originally and then went into the animatronic business. He built animated moving dinosaur figures and a gorilla to climb a building in Las Vegas and stuff like that. He was one of the founders of the business of putting coupons in the Sunday paper.

Hsu: Religious or political beliefs of your family?

Liddle: My family was moderately religious. My mother was quite religious and my father a bit less so, but pretty traditional northern Midwest religious views and community values, and so on.

Hsu: What were your favorite subjects in school?

Liddle: In…

Hsu: Growing up, elementary or middle school.

Liddle: Certainly, science and math, I can't say I really liked English very much, but I was good at it. That's really it.

Fairbairn: What did you do, did you read a lot?

Liddle: I did read a lot, I noticed a lot of what my father read too, so I would try some of the things he was reading on occasion.

Fairbairn: Was he reading novels or engineering stuff or what things?

Liddle: My father didn't read novels so much. He read a lot or nonfiction. Interestingly although he didn't practice religion a lot, he read a lot of comparative religion stuff. He found that to be very interesting. He loved science fiction, so almost the only fiction that he or for that matter my mother both read voraciously those little 1950's science fiction magazines.

Hsu: Were you really into science fiction as well?

Liddle: Yeah, you bet.

Hsu: So, it sounds like one of your early hobbies was tinkering with electronics?

Liddle: Yeah, that's right! I made a series of crystal sets and then a regenerative receiver. And I got my radio merit badge and so on. I was pretty into Boy Scouts. I was an Eagle Scout and got 36 merit badges and all that stuff. Hey, it was fun.

Fairbairn: Did your radio work get you into amateur radio or were you strictly on the receiving side?

Liddle: Well I did for a while, okay, when I still lived back there, I got into amateur radio. After I came back here I never picked it up again. W8RNJ.

<laughter>

Liddle: At least I can remember that.

Hsu: So, you went onto college at the University of Michigan and pretty clear that you wanted to do electrical engineering pretty early?

Liddle: Yeah.

Hsu: Any influential professors or classes?

Liddle: Well look at it this way, I'm 75 years old, so how old do you think those professors would be now? I mean I could name them for you, but they wouldn't exactly ring a lot of bells.

Fairbairn: More in terms of where they might have steered you or the influence they had on you.

Liddle: Right, I started out in engineering physics which is a little bit more of a device-oriented thing, but I kind of discovered that although I really liked electronic devices that I was kind of more of a systems person. But I loved electrical engineering period, I mean I liked circuits and I liked field theory and I liked transmission lines and all that stuff, you know. And it was just in my senior year I had a job in the electron physics lab basically programming to plot data points for some experiments.

Michigan had just gotten one of the first, what the hell is the number of that thing, 1421 or something, anyway the plotters, you know, the very first of those XY plotters. So, I got a chance to write the first program to plot data automatically, instead of doing it on crosshatch paper. And IBM was at that time building the first 360/67 on site in Ann Arbor at the university. So I got to hang around that a little bit and eventually to write some of the programming for those ridiculous, enormous 2250 graphic terminals. They were as big as a refrigerator!

But that was my start into human-computer interaction and displays and all that sort of thing. When I was younger, when I was about ten, my mother and my brother were away. My dad and I were home and the phone rang and it was the plant manager of the Burroughs plant in downtown Detroit where they built computers. I'm talking about 1955 here, and the plant manager said to my dad, "Your tubes are failing, there's a problem here." The memories were tubes of course, "So you've got to come down here right away." So, my dad didn't have any place to leave me so he packed me up and took me with him, and we went into the Burroughs plant. And two guys in white coats who are what we would later call SEs were stuck with this ten year old kid. And they took me up a flight of stairs, a metal gangway to the second story of this computer. It had been developed for Korea, a gun control computer, and they showed me a circular display that was plotting an Archimedes' spiral and every once in a while, bing, a point would be way off the spiral and they'd say, "That's why your father's here."

Well it turned out that what was wrong was not anything wrong with the tubes my dad sold them. It was what today we would call address skew. In other words, they didn't have the timing quite right as they thought that it was, and so now and then a point would get stuck out there in some funny place. But they showed me that they could calculate interest rates and a few other things, which I thought were pretty cool. And on the way home I said to my dad, "You know, I'm not sure, but I think this programming thing is going to be really big."

<laughter>

Fairbairn: And you carried that through, I mean when you were at the university you had introduction to the 360/67 or whatever…

Liddle: Right.

Fairbairn: Did you see computers as a key part of your future or were you focused on the field theory and other things?

Liddle: Yeah, that's a really interesting question, because they were both very important to me and I really liked more or less classical electrical engineering. But I could tell that the systems part of it was steadily drifting toward being done digitally. Michigan happened to be a place -- it was a leader in analog computing -- and there was a company there called Applied Dynamics that sold many of the very best analog and hybrid computers, but you could also sort of tell that digital capabilities were eating into what you used to have to do in analog design. So I felt like well, you had to kind of go with the flow there.

DARPA which wasn't DARPA then, it was ARPA, gave me the opportunity to go down to Toledo where the plasma display was being developed both for the University of Illinois Plato system, but also to go to Vietnam in a ruggedized display system. So, I really liked that because it was a digital systems problem and it was also an electron device thing. It was very cool and I loved working on it. And one time this funny guy named Alan Kay wrote a letter saying, "I hear that you-- a friend of mine says that you're working on this plasma panel, I'd really like to hear about that."

And so I sent him some stuff and the next thing I knew I was invited to a symposium at UC Santa Cruz by Harry Huskey, and they had invited both Alan Kay and me to talk about the potential for portable, small flat panel devices because his dissertation had been the famous FLEX machine and I had done this plasma panel work. That's how I met Alan Kay. And a couple of years later when I finished up my PhD and so on, I had come to the Bay Area for my last interview at SRI. I was going to work with Engelbart, and I even had a copy of his film and I came out to here to see him and to get signed up.

Meanwhile I went and had lunch with these guys at this funky new laboratory, you know, called Xerox PARC, because I knew some of them, Alan and Dick Shoup and some other guys from ARPA, from graduate student conferences and stuff and they said, "What are you doing now?" and I said, "Well I'm actually here, tomorrow I'm going to sign up at SRI." They said, "Well why don't you come and give a talk at our place, stay over the weekend, maybe you can put SRI off for a day or two and at least tell us what you've been doing, maybe there might be something for you at Xerox PARC?" And son of gun, I did stay over the weekend and gave a talk on Monday. I had a film of the latest thing I had done with the plasma panel and so on. So the next thing you know, there I was with Doug Fairbairn explaining to me how to wire wrap.

<laughter>

Liddle: I did go to go to work on the POLOS project and part time for the Learning Research Group, mainly interfacing devices for them.

Fairbairn: So, before you sort of jumped ahead there, the last time we were back in the University of Michigan, you were messing with 360/67…

Liddle: Right.

Fairbairn: …how did you get linked up with DARPA and then how did you get to Toledo in the process?

Liddle: DARPA, only I have to remember to call it ARPA then, was funding some of the work being done in Ann Arbor, some of the code being written for the 67 and moving some software from the old 790. Some written by Wendell Schultz in fact, and some which was a modification of some code written by Don Knuth and Bill Lynch. So what goes around comes around, you know. Anyway I was just about to graduate and this guy asked me, "So where are you going to go to graduate school or what are you going to do next?" and I said, "I just got my pre-induction physical notice, so I'm going to be carrying an M-16 I think. And he said, "Well let me talk to the people at ARPA and see what I can do." Got a call a couple of days later that said, "If you're willing to work on this project and are willing after it's over to be available on call for a couple of years beyond that, you won't have to go. We can give you a critical skills deferment." So I said, "Where do I sign?"

<laughter>

Liddle: And they had to explain to me that this would involve being in Toledo at Owens Illinois where this plasma display device was getting built and so on. But one of my instructors said, "You should drop in on the University of Toledo, they have a really good program for electrical engineers for a lot of guys who already have jobs and aren't on the loose." So I said, "Yeah, sure, I'll check it out." So that's essentially how it came to be. Just kindness and good luck that this guy had taken a small interest in what I was doing. You might know Dick Phillips, he's a pretty famous graphical guy in his day.

Fairbairn: So without the pressure of the draft, or the opportunity to go to Owens-Illinois -- before that developed, what was your vision of what happens after you get your bachelor's? Were you thinking you would go to work, or had you always planned to go to graduate school?

Liddle: That's a really good question too. I had always wanted to go to graduate school, but it looked so likely that I would be in the service. So although I had sort of sniffed around, I hadn't even applied. Had I been able to, I probably would have stayed at Michigan because I knew I had worked for these various professors, so I had good linkages there and I was pretty sure that I wouldn't have a problem being admitted and getting support if I didn't have to go.

Fairbairn: So, you were off to Toledo and Owens-Illinois, so Owens-Illinois was a glass maker?

Liddle: Yeah. Well…

Fairbairn: How did they get into plasma?

Liddle: Yeah, you ask a good question. Owens-Illinois was actually the largest maker of television tubes, because it's very much like making complex glass bottles, so they had a very big division that made these TV tubes for RCA. But they made special tubes for all kinds of uses and so on and…

Fairbairn: They made the glass part, they didn't do the phosphors and everything else or is that…

Liddle: It was a mixed bag. But what they did was make the tube -- the envelope and the faceplate. Then depending on what you wanted, you did the phosphors on the front, you know, somebody else did that. And they mounted some of the electronics into the glass. By that I mean the deflection coils and stuff like that, but they didn't do all the electronics…

<overlapping conversation>

Fairbairn: Yeah.

Liddle: Nevertheless of course they had to be very good at that crap, because they had to test everything and make sure it worked. But yeah, it's interesting that they didn't, they weren't what you would think of as a full up electronics company until they started on the plasma panel thing. The way that that worked was that Owens-Illinois, despite being in Ohio, was formed by a combination of the Illinois Glass Bottle Company and the Owens Bottle Company. Owens also being Owens Corning Fiberglass and Libbey-Owens-Ford, the glass barons of Toledo. In case you care why it should be in Toledo, it's because of the sand. The Lake Erie silica sand back then was much prized for making glass.

So, Owens-Illinois had linkages to the University of Illinois, where the plasma panel was invented or discovered, if you want to think of it that way. You probably remember this Doug, but it of course produced those orange dots, but it also had memory automatically. If you wrote something on that screen, it stayed. You didn't have to refresh it, rescan it, or anything. So a two-by-two little matrix was made at the University of Illinois and they showed it to the guys from Owens-Illinois and said, "We're just getting ready to build a great big statewide computer aided instruction system called Plato, and we've been worrying about should we try to put it on people's televisions or can we afford to buy enough terminals, blah, blah," all this stuff and they said, "We'd like you guys to develop this into a product that we could use for computer-aided instruction."

Now anybody who has seen one of those plasma panels knows that they're clear, that is the little dots appear very bright but they're clear. It's two pieces of glass with very fine gold lines on them. So they said, "And we're going to rear project from microfiche onto the glass, so we'll be able to do very elaborate instruction materials and so on and project photographs and x-rays and all kind of other crap on the screen and then draw the relevant symbology and so one digitally." And I thought, "Oh, that's pretty cool."

What ARPA wanted to do was to rear project maps so that in the field you could annotate this rear projected topo map with data about where troop concentrations or what have you. That was the idea and that's how Owens-Illinois wound up there and started a division called the Electro-Optical Display Device Division where I worked and did this stuff. At first, I was still in their research lab and then they spun out this division to do the work. So, it's a long story but that's how I wound up there, it was a very successful project in every way except one. When we started on it, memory prices were just getting to a penny a bit, in other words, you could buy a 512-bit shift register for five bucks, okay? When we finished the project, memory prices were below a tenth of cent per bit and falling, so the big savings that you got by getting this display and not having to buy a lot of memory to back it up sort of all went away.

Fairbairn: What year did you go to Owens-Illinois?

Liddle: 1968. So that's kind of the story of how I went there. Plasma panels live on in many places, about ten years ago, I was in a nuclear submarine with another Michigan alumni and this guy said, "Oh look at, wow there's-- " he had become a big shot at Northrop Grumman, he said, "Look at that, they're still using our inertial guidance system." I said, "Hell, they're still using my plasma panel <inaudible 00:24:26>."

<laughter>

Liddle: That's one of the good things about the military, if you get designed in it stays for a long time.

Fairbairn: Stay for life. <laughs>

Hsu: Okay, so you mentioned, so you started at PARC in 1972…

Liddle: Yep.

Hsu: …and so you mentioned that you were mostly on the POLOS side in the Systems Science Lab but you also did work for the Learning Research Group?

Liddle: Right.

Hsu: So, you were mostly focused on the POLOS display for that?

Liddle: Oh, not really, I mean at first that was what I worked on, but at the beginning we were still testing the displays and the display controller and all that, making sure that it was going to work well enough. I made this test device so that as they came in, we could check them and so on. But then I did a bunch of performance stuff counting procedure calls and that kind of stuff. Timing some of the operating system things in the POLOS system, and then I did a lot of human computer interaction stuff, looking at models of text editing and pointing and all that kind of stuff.

The mouse had been around at SRI for a little while and other people especially Doug actually, if I remember right, did a lot of work to make a really good commercial quality relatively low cost, small, manageable nice mouse instead of the big rat from SRI. And the other thing was the corded keyset. We had this five-key keyset, which you probably know about, and I still can remember phrase paragraph and delete, because they were all binary codes. With your fingers you could do 32 things since you have five and there were only 26 letters in the alphabet and a few other things.

Fairbairn: Plus, you had three buttons on the mouse so you could…

Liddle: That's right! You could set the case and all that stuff.

<overlapping conversation>

Fairbairn: Shift keys.

Liddle: So anyway, I studied a bunch of that stuff. Actually our mutual boss then, Bill English, was one of the guys who had designed much of that while at SRI. But what we found was that it [the keyset] was tending to slow people down, once you got away from really hot shit system programmers. It wasn't quite so good if you were giving it to other engineers, let alone clerical people and so on. So, we brought in a bunch of those people and tested them and modeled them and all that, and I wrote voluminous, tedious papers about what we were learning. One of the interesting things I was, I remember this. I said, "Oh no, so you forgot to delete the carriage return." She said, "How do you delete a carriage return, that's an event, isn't it?"

<laughter>

Liddle: I thought, "This lady has a good nervous system." I said, "That's right, inexcusably, we call that character a carriage return." Anyhow there was a lot of stuff like that thinking about paragraphness, you know what I mean? Is it a paragraph because it's terminated by a carriage return?" You know, you get what I mean? So, I did a lot of that kind of work. And that was still in PARC. Then in early 1975, January of 1975, Harold Hall was asked to start up a group to actually try and take some of these PARC ideas to market, so he asked me to go with him and be kind of the original founding … you might say CTO or whatever of this group. And I wrote a long paper, a document…

Hsu: We'll get to SDD, but I wanted to step back and actually ask about that-- to stay with that earlier period a little bit. I think it's very interesting that you had wanted to go to SRI, but that you ended up at PARC but basically working on essentially the NLS 2.0 in POLOS, so would you have been doing something similar had you been at SRI or…

Liddle: That's a little bit hard to absolutely determine, but the SRI version of NLS of course relied upon passive terminals with very high quality displays and graphical capability -- and in fact the ability to process ordinary video. But nevertheless, they were timesharing terminals, okay? So POLOS went down much that same path. But the thing about POLOS was it was meant originally, even before I got there, it was meant to be a system to actually serve the PARC laboratories. It was of course an experiment but I mean it was meant to be matured to the point that it was the terminal that everybody would use.

Well in the middle of all that, both in Xerox and in SRI came the idea of, "Well why don't we have more intelligent terminals?" in other words, maybe the right thing to do is not to have all the logic of this timesharing system all be centralized in a PDP-10 or some equivalent device. And so, I think what I would have been working on most likely at SRI was the idea of … They were going to move to more intelligent terminals. I had sold them one of my ARPA terminals, a plasma display and a Nova. So it was now an intelligent terminal that did all the processing for the screen and editing and all that kind of stuff locally. When I sold it to him, delivered to them, you had to read a paper tape into it. In Vietnam it was an aluminum tape, but it was the same thing. However, Smokey Wallace immediately wrote a thing so you

could download it. You could boot load the program from the PDP-10. So that's what I would have been working on there.

And at roughly the same time in PARC, we had this network of Novas, and we were now starting to put, and I know you cover this material elsewhere, starting to put Altos on that network. So we were moving toward the user-server or client-server… We didn't call it client quite that early, but the ARPANET idea of a using host and a serving host. The using host handled you, the user host painted your screen and all that and then it went across a network to the serving host which did whatever computation it was you were going to access. So that idea kind of already existed and that was just waking up really in PARC.

I worked on a piece of software originally written by Bob Sproull which had the funny name of New MCA and then Ether MCA. The MCA was the name of a Data General thing, the multichannel adaptor I think, that allowed you to do this multiprocessor networking on Novas. It had been rewritten a couple of times and I worked on that for a little while. And then right around this time is when I went off to SDD.

But the work I would have done was probably somewhat the same, difference being that there was a fully deployed system at SRI, not only to the SRI engineers but also at some customer locations. At least, I'm going to say I think by then there was already one at Rome Air Development Center, maybe someplace else, too. So things were being done at a higher level by then. That is, they were spending a lot of time at SRI thinking in a very interesting way about what it meant to have this office system and how it would change your life.

Whereas at PARC, understandably for Xerox, we were all about beautiful things getting printed. It was all about fonts and typesetting of equations and all that sort of stuff. The reason that this was attractive was we know how to make a really good random access printer, that is a scanned laser printer, that you could pretty much do arbitrary imaging on. Nobody else began to be able to do that at that time. So the idea of doing these things with the Alto and then of developing the Star was to let people like ourselves, who wrote papers for conferences and stuff, be able to create these arbitrarily beautiful typeset documents that couldn't be printed on anything except Xerox equipment. That was the whole idea and the reason why there was support for doing what otherwise looked like a computer, a business that Xerox was just going out of.

Hsu: Could you talk about what you were doing for LRG?

Liddle: Interfacing things. Oh, about every six weeks or two months they'd buy one new peripheral of some kind to try it out, including the famous Spark Pen. I forget what that was called. But anyway it was a glass panel that sat on your desk, and it had long, narrow strip microphone down one side and down at the bottom. When you touched the pin down someplace it made a little spark right at the pin. The spark produced a circularly-radiating acoustic wave, and a little timer would start for x, and a timer would start for y, and when it hit this microphone, it shut off that timer, and when it would hit this one it would shut off that one. Those two time delays told you the x,y coordinates. And I had looked at lots of different light pens and interaction devices anyway. So that was one of the first things I did for LRG was to interface it both to the plasma display and then to a different device that they had.

So that was typical. But there were musical instruments of various kinds that we interfaced and so on, and it was just every now and then Alan would come and ask me if I could do something by this afternoon, interface something. It was very cool. I can see him clear as a bell, the day that the spark pen thing came in-- I had helped him to order it. The day that it had arrived he was walking down the hall toward me, eating a chili dog with one hand, and he went <gestures>, which meant to me, "When are you going to interface my new Spark Pen?"

Hsu: Were you involved in the Research Character Generator?

Liddle: Not really. No, not in any meaningful way. I would talk to [Ron] Rider about it, but it was still of the era-- Doug and I, to name but two, worked on this idea of fixed logic character generators as opposed to a big bucket of memory in an Alto, okay? And so, the RCG was like that, that is to say it was a character generator. That's what it did. It didn't do anything else particularly but did do that. And the RCG was good enough that Printing Systems' Division just picked it up wholesale and used it to drive the big computer room laser printers that they were selling.

Hsu: So, you mentioned earlier that the computing was moving to the terminal, and while you were working on POLOS, the Alto suddenly emerged. What were you seeing from where you were, and did you get involved in any of that effort?

Liddle: Oh, yeah. Oh, yeah. First of all, the Alto was a project done for the Learning Research Group by Chuck Thacker and others in CSL. I have a hilarious picture of me with my shoulder-length hair and a big, bushy beard, and I'm working on the Alto display controller. It was called the interim Dynabook. Bob Taylor eventually decided that that was A) a mouthful and B) not the only thing that it would probably be good for, whereas Alto sort of meant Palo Alto and so on. So it didn't suddenly emerge. It came out gradually, this featureless cube with a POLOS display hooked to it, but a priori the thought was it was going to be used with kids, and it was. They put a bunch of them at-- oh, what was that school, Doug?

Fairbairn: Just over at Stanford?

Liddle: No, but there was an intermediate school.

Hsu: It was a middle school, right?

Fairbairn: Terman.

Fairbairn: Here in Palo Alto?

Liddle: Yeah. Yeah, Terman.

Hsu: Terman.

Liddle: Terman. Right. So, they were using it with kids. That's how it started its life. But there were several important things that were done. One was rather than develop a whole new programming system… We were writing in BCPL for the Nova because we had all these Novas around that we used for POLOS. So it was decided that the microcomputer structure, the bit slice structure in the Alto… You could microcode it to do whatever you wanted. So the idea was we would use the Nova instruction set, except for the I/O, because we already had software tools that would work in that environment. And we would write an emulator. Its name was Emal, emulator that ran in the Alto, as the low-priority task. That is, a high-priority task was, "Here comes the display scan line." There's a bunch of those. Then "Here comes a sector pulse from the disk drive. Better do any stored reads or writes." And then every once in a while, "Something just came in on the Ethernet." Okay.

And then when all that was done and the bartender is polishing the glasses, as it were, then the emulator ran the program. So there was already quite a bit of compatibility in the way we were doing business. People quite understandably started hooking up Altos to program on because you could write BCPL on them. You could do all the same stuff, and they were actually a lot more congenial to build certain kinds of programs for, than was the Nova.

So I wouldn't think of it as suddenly popping up, but rather becoming an office tool rather than just a thing for kids. Meaning the LRG stuff that they were trying to do with kids was very serious. It was well done and very careful and so on. They had a lot of ed psych people looking at it and so on. I don't want it to sound like it was anything shallow at all because it wasn't a bit. But it also was the case that building on that device changed the whole view of what an office system ought really to be.

Hsu: So it sounds like the Alto just almost organically started to supplant what POLOS was supposed to be for.

Liddle: I think that's a very fair way of describing it.

Hsu: Okay. So, yeah, let's go back to talking about starting SDD. So, you mentioned in '75 Harold Hall asked you to join him.

Liddle: Right. There was a lot of excitement in PARC about this different stuff we were doing. That is by comparing it to other stuff that was out there in the world. We thought, "This is really different and something new." Butler [Lampson] wrote a famous paper called "Why Alto?" which I'm sure you have here. It talked about it being the path to decide whether or not our ideas about personal computing, as he put it, were valid, were good ideas. We had a few "intelligent terminals" around, IMLACs, and we began to realize the limitations of them, and that Alto had the promise to completely wipe out that whole set of ideas of hyperspecialized graphic terminals.

But because there was a lot of excitement about what would be done here, and because I had had some industry experience and so on, Harold Hall asked me to write the OIS architecture document to just try to spell out -- looking at the PARC research that we had through a somewhat commercial lens. In other words, what would it look like to build an office system of this sort of stuff and what strengths of Xerox did

this play to, as well as what should the structure really be? Meaning you needed a processor architecture, which was the Mesa PrincOps. That was back when people knew what architecture was and they quit calling "design" architecture. Computer architecture is exactly not design. What it means is, "These are the instructions, man. You can implement them any way you want to, and if you follow these principles of operations, programs will run on any computer, big or small, that implements them."

And that was what we were striving to do, because we believed that we would be making electronic printers and big electronic copies and workstations and file servers, mail servers, and we had a thing we called a COM server. It was basically a router, a bridge, and a gateway all in one, and strung all those things on an Ethernet. So I wrote that document, and while I was writing it, I talked to some of the people in PARC, who were working on relevant things to make sure that they thought what I was writing made sense.

A number of them mentioned to me the idea that they would like to sign up and be part of it if we were going to take this to market. So that included Charles Simonyi and Ron Rider, and ultimately Chuck Thacker, and it was a really strong group and Ed Satterthwaite. This is a strong group of people who already knew this stuff, had it under their fingernails for a couple years, and so we were able pretty quickly to show to the corporation a prototype of what such an office would be like.

Hsu: How did you get tapped for that? Why did Harold Hall choose you?

Liddle: I don't really know. Harold Hall has said in the past to me that he thought that I explained things very clearly and that that was going to be a critical thing. He said, "I know you know what you're talking about technically, but we have a lot of people here who are like that." But he said, "If I have to go back and forth to Connecticut to get things done, I need somebody that's sort of willing to try and put things in a context that will be understood in the corporation." He did say that to me, so I suspect that's a part of it. I don't really know why he chose me because, goodness knows, you couldn't throw a brick without hitting a Turing award winner at PARC.

Fairbairn: So, I'd like to sort of set the stage for one of my hot buttons for this interview and other discussions we had about sort of the whole issue of time versus capability. So, I fully remember everybody's frustration, knowing we had the future in our hands here at PARC and why couldn't we just take it to market, and tell the world, and get going on this? With the benefit of hindsight, I realize that was the right thing to do 20 years later, but in 1975, 1976, I think it's important for the viewer/reader here of this interview to set the stage of what was going on at that time. We barely had the 8-bit microprocessor. Most of the world didn't know or understand that they would ever want or need a personal computer on the desk. The idea of a personal computer was brand new to the hobbyists at that time, and here Xerox had in PARC clearly the future of computing in terms of user computing. I give tours of our exhibit downstairs, and we have the Alto, which is right here, and then right next to it is the Apple I, which essentially, we're in the same time space, 1975, 1976. One costs $10,000 in parts and would have had to have been sold for 40 or $50,000 at the time. And right next to it is the Apple I, which could be sold for $666. Obviously vastly different in price. But tell me what was your vision, what was Xerox's vision, what was Harold Hall's vision in setting down this path -- of taking this wonderful technology to market, and

was there a timeframe or was it just, “Let’s see how far we can push it”? What was the sort of market product view that you had at the time?

Liddle: Well, all of this stuff, including the existence of PARC, sprung from a speech given to Wall Street by Peter McCullough, who was then the chairman and CEO of Xerox, and they wanted to know what did he see for the future of Xerox, and he said, “I would like for Xerox to become the architects of information.” This was a very useful thing to say because it was vague enough that you could do quite a number of things under that rubric, but what was the real point of it? The real point of it was Peter McCullough’s belief that we were not going to be cutting down trees forever and filling up metal file drawers with paper and stuff like that, and that that ultimately would be the end of the xerographic business as we knew it. So he wanted to have a bridge to a future business that was about processing information and about the enterprise, if you will.

Now one of the things that they did in that connection was to buy Scientific Data Systems. This was an era when minicomputers were all the rage. For the first time there were real alternatives to buying something from IBM or Honeywell or Burroughs or something like that that was quite expensive and had to have a dedicated priesthood of people taking care of it. And at that moment SDS was the minicomputer company, and they had made their bones on scientific computing, simulation, and automatically running experiments and all that kind of stuff. That was their deal at SDS, and a bunch of guys, who later came to Xerox PARC, but were then at Berkeley, on the SDS 930 they built a time-sharing system and called it the 940, and this was a change to the computer business that was pretty important.

Well, next thing you know, Digital came along, and then Data General, and then Wang and Prime, and all these minicomputer companies started not just taking a bite of the existing business but growing it like mad, right? So, I think that they bought SDS because they believed that you had to have a minicomputer business to participate in all this growth. The thing that turned out not to have been so good was they made a turn away from the scientific and real-time computing toward business data processing. Now SDS found itself competing with IBM and Honeywell and Burroughs and all these guys, and that did not work out so well. And in 1975, six months after I had gone to work with Harold Hall and just as I was building out a team, Xerox went out of the computer business and sold what was left of it to Honeywell. But the good news of that was they left behind a lot of really good talent in El Segundo. And so the one thing we didn’t have in PARC was a lot of management, and so we could get some pretty good product development engineers and pretty good management people, and test people and all that, who had been spared because they were highly rated and had not wanted to go to Honeywell.

So here is Xerox now saying, “We can’t cut down trees forever, and we don’t want to be in the data processing business.” They bought Diablo over in Hayward, which had this very cool daisy wheel printer and fairly good disk drives, too. They bought this printer and put it into the office products division down in Dallas and made a clickety-bang electromechanical word processor. A pretty damn good one too, which took a bite out of IBM. But the era of electromechanical text processing was also coming to an end, so what I’m saying here is from a very wide portfolio of stuff, it was beginning to narrow down. Xerox still owned a lot of storage companies, Shugart, Century Data Systems, and so on, and they had this

promising work getting done at PARC, and they had a division down in Los Angeles that could sell the laser printers into data processing centers.

But the view was, “Okay. Documents are us, and we don’t have to do a broadly-based computer business, and we don’t want to do a narrow, word processing only business. Let’s see if these PARC guys know what they’re talking about, and make a run at a professional workstation. The idea here being that rather than rewrite a paper and then you try to find some way to get it typed, you composed it, right, as you were going along and writing it, and you put in your equations, and it automatically indexed the Sigma and all that stuff. So now you’ve finished with something that looks like it’s been typeset in Holland, but it wasn’t. It was just coming out of your own laser printer. That was the view and that we would allow people to make documents of every kind, graphical and image-oriented and everything, that nobody else could print, and that view essentially carried the day. That became the way to look at this. These guys are doing an office system. They’re not in the computer business, and they’re not doing a word processor. They’re building a broadly-based office system that will get used by professionals, not by just clericals.

That was the evolved view, and of course we talked that up all the time because for one thing it was true. Alan Kay used to say this thing about, “If you can, you want to build what you use and use what you build.” And that was one of the things about PARC is we all wrote papers and stuff, and so building a system that made you really good at doing that was really attractive. And people put a lot of energy into it. We started out with other tools. We had simple text editors like Poet and so on, and we had PUB, which was a document compiler, but you embedded a lot of terms in it. You know what I mean? It didn’t just do What You See Is What You Get and, bang, produce it. So everybody was more than willing to roll up their sleeves and be a part of getting this done. That really helped a lot. Here, I had this early, almost embryonic development organization, but the research labs did anything we asked. They really piled on and helped us a lot. You almost couldn’t tell where the lawn was, where the border was, so that was the view.

Now, this question about the timing. It’s certainly the case that if only the Motorola 68000 had been a little earlier because we had no choice but to build the Dandelion, all the office processing. We had to do them all in bit slices to get the performance that we needed, so that naturally meant it was going to be a more expensive device. The rest of the world wasn’t moving very fast because they were using 8080s and 8085s to keep the price down, but those products really had very, very limited memory access, small addresses and all that stuff. So there was this gap, and we had no choice but to fill it ourselves. It was just a couple years later that the 68000 came along, and the company that I started after Xerox, Metaphor, we used the 68000. Sun was using the 68000. Eventually even Apple used the 68000 because it was kind of a real computer with a big flat address space and all that stuff. It wasn’t a jumped up controller like the 8080.

So, time scales being what they are, instead of having to sell a workstation for $13,000 we could have probably sold it for about 7 or 8. We wouldn’t have been down selling it for 4 like a personal computer costs. It was still a specialized thing in the sense that it was used in the office. There wasn’t any notion that people would have things like this at home, but they were heavily used by professionals. I can

remember the first time I ever heard somebody use the expression about something going ballistic. I was at Martin Marietta in Denver, and they had a bunch of Stars, and every once in a while, Star would crash, and so the screen would go black, and this one guy came in to see me. He says, "Come here. I want to show you this. Star's gone ballistic." And I said, "What's that mean?" He said, "When we lose control of a missile it goes ballistic." Isn't that funny?

Fairbairn: So you said about on this program you had to develop a whole new processor. This wasn't the Alto. This was modeled on the idea of the Alto, but you were starting from scratch essentially, right?

Liddle: Yeah. In fact, let me add one point about that before I forget it. Here's what's important. The Alto was still built in the style of things like the Nova, but in the Nova every controller was a whole big board, and the Alto implemented some of the controllers in microcode. So there were a few big boards in an Alto but not so many. In the Star and the other processors in that family, we took it to an extreme. That is, the Dandelion, it did as much as possible with microprocessor. It had very, very little fixed logic for controllers, mostly just [Serdis?] 01:06:01 and stuff like that, and that was really important. That was a big change. Butler [Lampson] really is the one who helped us get that right, and if it hadn't had been for that, the Star would have been enormous and clunky. So we were able to get it into a sort of desk side office-like structure by virtue of that. Sorry, Doug, go ahead.

Hsu: Before we go really deep into the hardware, I wanted to go back to talking about the division, the organization. Earlier you mentioned that you started off with Thacker, Rider, Simonyi, Satterthwaite, a couple people from PARC who joined, so it was pretty small initially, but then you got the remnants of the XDS El Segundo operation. How quickly did the division grow, and then how difficult was it to manage these two separate groups?

Liddle: The two separate groups wasn't too bad. I brought a couple of the real stars from El Segundo up to the Bay area, and that helped a lot because they knew all the guys down there and so on. You know what I mean? Ron Rider was the only guy from Palo Alto who ever went to El Segundo, but he did for a couple of years and then came back. And Metcalfe had joined up with me at the beginning. After a couple years he got hired away, and he went down to Los Angeles to work for Transaction Technology, but I managed to get him to come back, too.

It was not that bad to get on Southwest on Monday morning. The Hertz lady would see me 100 yards away, and she'd have out my little envelope, ready for me, and so every week Monday morning I went to El Segundo. Tuesday afternoon I came back to Palo Alto. It wasn't bad, and the-- as I said, they had good development management kind of skills. That really helped us a lot. Wendell Schultz, who came from El Segundo and had been a lead on two operating systems at least, he came to run our system-software activity. Don Charnley, who'd been a real star in the microcode of those machines, came, and he ran all of that. He did all that for us, and he moved to Palo Alto. And so, actually, it wasn't all that bad. If I'd had a group in Webster, New York, or something, that would've been harder. A few years later, I had to add another day to that route, because I had to go down to Dallas, because suddenly I had a bunch of people in Dallas, and my new boss then was in Dallas, but so was the sales force and so on. So that was kind of okay. I guess it just wasn't the hassle then that it is now to travel.

Hsu: Culturally, was there a divide between the two groups?

Liddle: Only modestly. Both North and South, the management mostly, not solely, but mostly were old El Segundo guys, but they were mostly hiring brand-new young people. We'd have people that wanted to come to work in Palo Alto. We didn't have a slot for them, we could send them to El Segundo and so on. So, most of the teams were pretty young, energetic, new computer science or EE grads. So, no, they weren't very culturally different. I mean, once in a while I think the sort of old-school operating-systems guys didn't quite understand why we wanted to have atomic transactions and coroutines and ports and stuff like that, but they went along with the gag when it was kind of proved to them in a good way. I still remember John Wick, who ran the Mesa and the Tools outfit. He would quote Wendell Schultz. He would say, "Wendell's first law says you have to do so-and-so," because they had been literally kind of tutored by the El Segundo crowd, so…

Hsu: So the research and development was done in Palo Alto, and El Segundo was focusing on manufacturing, or what was the divide?

Liddle: No, no. I mean, the electronic manufacturing, meaning the boards and stuff, that was done in El Segundo, because the factory was right there. But the design group that designed the processor and so on, it was split between the two places. There were processors, designers down there, and Chuck Thacker and his guys up north…. In fact, Chuck managed some of the people in El Segundo, too, and in software-land, nominally we did user-interaction design and system software in Palo Alto and "application software," in El Segundo, meaning the guts of the text processing and all that sort of stuff. But as a practical matter, there was a great deal of crossover back and forth. We wrote an enormous functional spec, best functional spec I've ever seen. I bet there'll never be a better one. It was probably 200 pages thick, and it called out everything, everything you would do for 10 years in terms of how it looked to the user.

Fairbairn: You alluded to it as you've talked, but I think it's important to explicitly describe the scope of the development. If we think about it today, there's so much to build on. You didn't have anything to build on. You were designing a new computer with a new language, with a new operating system, with a-- and building applications that had never been built before.

Liddle: That's right.

Fairbairn: So, tell me. I've sort of alluded to it, but, I mean, sort of go through that whole thing and-- let me just jump ahead and say, when did-- you started in '75, '76. When did this change from a, "Let's figure out how to take this to the market somehow, some way," to, "Okay, we're going to take this product to the market, and it's going to come out in Y and it's going to cost Z"?

Liddle: Okay. First of all, that first point that you made is true. I remember one guy, good guy, smart, energetic executive, said to me, "You must be crazy. You're doing a processor architecture, an operating system, a programming language, tool system, a network, da, da, da, da, da." Okay, and what I said at the time, and I meant it then, and in a way, I mean it now, it's always been the way I've looked at it.

Software's hard, and it's really-- ultimately, it's everything, and software is much too important to leave to somebody else's hardware. I mean, if you really know what you want, you don't compromise it because you can't find the hardware that does it. You go make the hardware that does it or find it someplace else.

Now, sometimes that approach has served me well and sometimes not so well, but all you got to do is look at the 1st 3.1 releases of Windows to realize how true it is, okay. And hopes and prayers and everything else don't change an 80186 or 80286 into anything that you can really use to do the kind of things we were doing. You can't do that. I felt that we were doing the right thing. The programming world was not designed for the kind of programming we were doing. These graphical user interfaces, that's real-time computing, okay? And so all the programming languages that were in existence had been spawned-- intended to do batch-like computing. All real-time stuff that was out there, it was all written in machine language. I mean, it was just hard-coded like the-- for-- Honeywell's probably still selling Sigma 7's, because there were a bunch of countries in Latin America that all got together and wrote flight simulators for the Sigma 7. And nobody wanted to pay to move that stuff, and it was all machine language, as all real-time was back then.

Well, we were doing real-time computing. We were tracking the mouse and moving windows and all that kind of stuff, and you know how frustrating it is when there's even a short delay from a manual input. So, we had no choice, and we certainly had good prototypes and good evidence of what you had to be able to do. You were asking me earlier about when I was working on POLOS, making all these instrumented measurements of text selection and deletion and all this stuff. And it really showed you that after 80 milliseconds, it's cold pizza, man. You can tolerate a very tiny lag, okay, but the human being wants to operate at 12.5 hertz or go home.

So, anyhow, though, biting off that whole, big chunk was both good and bad and made it harder, made it, to some extent, take longer -- and Xerox was going through tough times then. So, some years I couldn't get all the resources I needed -- meaning all the dollars I needed, so we had to slow things down some. But if you look around out in the world, I mean, networking is Ethernet, okay, and Java is really Mesa. And you see the impact that was produced by that, and by the fact that we did all the work to productize it so we knew what had to be done.

It was always amazing to me how long it took for other people to be able to render fonts and stuff like that. But taking on that big a project, it's funny. Some companies, it would've just been out of the question, but Xerox was used to big, long developments. I mean, Jesus, the development of these big copiers and duplicators was very extensive, and all the senior management were guys used to that. I mean, one guy who left from running the biggest division of Xerox went to become the CEO of International Harvester, okay? Another guy had been doing missile systems and stuff forever, okay? So we had this phase program planning thing with staged product development, concept phase and feasibility phase and design phase and-- or development phase, design phase and then into manufacturing, okay?

You can imagine how long that makes things take. On the other hand, it means when the shit gets out of the factory, it works! We never damaged Xerox's reputation. We never had quality problems or anything

like that. Final assembly was always done in Dallas, but the electronic stuff was done in El Segundo, and that all hung together, but it was about software. I mean, it was just necessary to find the right setting for the software.

Hsu: Could you talk about the turmoil in the management? You went through-- Hall left pretty quickly. You had then Steve Lukasik, Bob Spinrad, and then eventually you got the top job. Could you talk about that?

Liddle: The day that I got that job, Harold Hall said, "I know exactly how long you're going to be in this job," and I said, "Why?" "Hall, six months. Lukasik, 12 months. Spinrad, 24 months. I figure you have 48 months in front of you, Dave." It was upward turbulent but not downward. In other words, we were in different parts of the corporation, because the corporation was itself morphing and changing. But nothing was done internally to the path that we were on. What I mean by that is, Harold Hall agreed with what I wanted to do and defended it. So did Lukasik, and certainly Bob Spinrad did. My joke used to be that we would-- I mean, we'd have to go a couple times a year back to [Xerox corporate headquarters at] Stamford to justify our spending and be given our allocation, so to speak, and I used to say that when we went back there, Spinrad was the organ grinder, and I was just the monkey holding up the little cup.

But, of course, he was a master at getting things teed up before we got there. He came, of course, from-- he was the VP of software at SDS, and he was very, very, very famous for being the first guy really to work out a protocol for automatically controlled experiments and so on there. So he was technically very good, and he understood the care and feeding of technical people really well. So, he especially worked hard on our behalf. But I have to say that Bob Sparacino, who was the head of the big engineering outfit, he was good to us. He was supportive of us where people thought that he might not be, and he was.

There were some executives who just didn't like it, because they thought two things about it were a problem. One, they felt that we were under terrible pressure in the copier/duplicator business, scary new competitors, and our patents were running out, and so they really felt like the company should just be sticking to its knitting, not worrying about successor businesses yet and so on. There was also kind of a view that, look, we made our try at the computer business. We got out of it. We can't do the high-end computer business, and we don't want to sell stuff like Apple for nickels and dimes, so there's nothing-- no space in between there for us.

But the stuff was good enough, and it stood on its own. The most senior guys in the company would look at it and say-- they'd let everybody have their say, and then they'd say, "No, we're on a good path here. I haven't seen anything else that can be a successor to the businesses that we're in." And so we were moved among these different divisions. I don't know how much of this is relevant, but there was a spasm in about 1980 or so, because there was one particular executive that they were trying to keep in the company, and so they reorganized briefly into this thing called Xerox Business Systems. It had electronic printing, because this guy had been running electronic printing. He'd come from the computer business. And they put SDD in there and the electronic printing stuff and Xerox Computer Services, stuck them all in this one group, and then the guy left anyway and went off to be the CEO of Amdahl.

So, then I was working then for Jim Campbell, who had Xerox Computer Services. He had sort of started that, and he had us, and the long knives in Stamford were saying, “We shouldn’t be doing this SDD, OIS stuff. There’s nobody can sell. There’s no sales force that can sell it. We just ought to cut our losses, and we can put those guys on the electronic-copier projects, which are way far behind.” And they said, “Well, let’s have them go down to Dallas and see what Massaro can do with this thing.” And Don Massaro, who had been the CEO of Shugart when they acquired Shugart-- and they sent him down to Dallas to run the office products division, and he didn’t really like what he saw. I mean, he knew how to energize the place. He was a classic Silicon Valley guy, but he thought, “This is a tough way to go here.” They had by then a display word processor, not just that electromechanical one. It was based on the POLOS display, but it was still 8085-land.

So, I shipped an Alto down there, and I went down with Jim Campbell, and here’s this sort of smartass, pushy guy. I love Massaro. He’s really great -- nobody pushes him around, you know what I mean, and so all his guys were all kind of-- we had a little-- set up a little presentation, then I did a demo. And you could tell his guys were just saying, “Get ’em, Don. We don’t want this other competitive product. Get ’em,” and so I gave this short, little thing, and he asked me a particular question, and like an asshole, I said, “Well, I could answer that for you, but I don’t really think you’d understand it anyway,” and I could see all these guys are kind of looking at me like… What the hell do I have to lose? I mean, I’m trying to be straight with this guy, and he’s got somebody telling-- “Ask him about this.” Anyway, then I did the demo, and he said, “Hold it. Hold it. Wait a minute. Wait a minute.” As I was finishing, he said, “If you’re trying to convince me that you know how human-computer interaction is supposed to work”-- and I didn’t even let him finish that. I said, “I’m not trying to convince you of anything. I’m showing you this product, okay, because I’ve been instructed to do that.” I didn’t think he’d touch it with a 10-foot pole.

We flew back to California, and the next day he had said-- he called up his boss, John Titsworth, said, “I want that in my division.” He said, “They’re spending $10 million a year, Don. We can’t give you $10 million worth of product relief-- or profit relief.” He said, “I didn’t ask for any profit relief,” and he went around and taxed all the other businesses in his division to pay my $10 million, okay, because he saw it. He got it like that! And from then on, suddenly, I had a factory to do the final assembly. I had a sales organization and a service organization and a marketing organization, and so he said, “You need to just be the general manager of all this now. You can’t just run the development, because we’re getting close to the endgame, and we need it anyway.” So, at that point, suddenly, I’m the business guy, and that was in late ’80, I think.

Hsu: So it sounds like it was the transition to really product-- actually shipping the-- getting on the train to shipping the product versus it was still sort of research and development.

Liddle: Yeah. I mean, that’s right, except, I mean, the hell of it was, you see, we-- the design was basically all done, and they were making boards for us down in El Segundo, and they’d be saying, “So how many do you want?” and all that, because, I mean, they set up a line to do it, and Dallas guys were anxious to have something else assembled, you know what I mean, and yet I didn’t have a sales force signed up to sell it, and this changed all that, and even-- so then, even before we had an inventory of the things to ship, I had salespeople bringing their customers to my offices in SDD, and we’d demo the

prototypes to them, because it was causing them to buy all the other stuff. All of a sudden, the printing-systems division guys are after me and the copier-duplicator guys, because they wanted to show off, so to speak, for their good accounts. So, yeah, that was definitely the turning point.

Fairbairn: At what point did you have a marketing plan of how many you were going to make, and who was the target market, and you have this 200-page development spec. Where was the equivalent marketing spec? When did that happen?

Liddle: We did that work in 1980, and we rushed one product, the file server. We rushed it to market, along with an Ethernet controller for the-- what was its name? What was its number? The 860. It was a word processor, but it was-- had an 8085 in it. It was kind of programmable, and so we put it on the Ethernet and connected it to this file server, so in a word-processing center you could have a file server and a whole bunch of these connected things, storing and exchanging files. They still did the regular sort of boring text processing, but that product was announced in early 1980, and it was based on a marketing spec that was done in fall of ’79. And then of course the Star was launched in spring of ’81, and by then we had pretty good marketing plan. Xerox was always really willing to invest in market research, and they had a good team that did market research and, in fact, built a model and so on, and we had some measure of cost sensitivity and all that stuff.

The trick was to get the sales-- see, the salespeople always wanted to show it to the word-processing people, but-- and there were a lot of display word processors by then, Wang and CPT and all these guys, but that wasn’t the right people to show it to. So, the biggest part of the marketing job was to give the sales force the materials to get in the door and call on the technical people and the brand managers and all these people that could use it if they only knew about it. That was the hardest part, but it was going along really well. We made a profit in that first year.

Everything was unfolding nicely, and then in one of those organizational spasms one guy wanted to have all the sales forces report to him, that is, the guys selling copiers and duplicators and the people selling facsimile and the people selling electronic printing and people selling our stuff, and I knew that wasn’t going to work. I could already see that this was more than the word-processing sales force could sell or the-- and we had control of them. We could train them and so on. So, ultimately, they took away the sales force, and so ultimately Massaro and I left and started Metaphor.

Fairbairn: So would you say that decision, the sales-force decision, was sort of the critical blow that Xerox could’ve built on the momentum you established and…

Liddle: I don’t know, okay? I don’t think it would be quite fair to blame it on that. I think that was certainly a turning point, because now, I mean, when you got a guy who’s selling $7 billion or $8 billion worth of stuff, he’s not going to spend a lot of time on $70 million or $100 million worth of stuff. And you had a big guy running a big sales force, and there wasn’t really a lot of devotion to getting this done. I think that was a mistake for Xerox to reorganize in that way. Does that mean that we could have done better, done differently if that hadn’t been true? I’d like to think so, but I’m not sure that that’s right. By now, the IBM PC was there, but it was not very capable, you know what I mean, from a point of view of a professional

workstation. But Sun Microsystems was already started. Other people were doing, quote, “workstations.” That was when there was a whole industry that was workstations and another whole industry that were PCs, and the idea of an office-professional workstation hadn’t really sunk in deeply yet. Whether we could’ve done that, I don’t know. I mean, we certainly would’ve been working hard on it, but whether that would’ve changed all the outcomes, I don’t know. I think cost was not insignificant. I mean, if we had built on the 68000, who knows? What we could’ve done, because a couple years later we made a good Metaphor workstation that-- I guess we have one here, actually, that was high performance and small and all that, and we sold it for $4,000, and it was very profitable. So the falling prices of memory and the idea that you could use peripherals that weren’t next to you, because you had the Ethernet and high-resolution display, that just got better and better.

I think the Star would probably have run into some headwinds at that point. The headwinds wouldn’t have been Lisa, I’ll tell you that, but it was clear-- nor, early on, Macintosh, but it’s clear that Apple saw the fact that this kind of interaction, the graphical user interface and the ability to print arbitrary documents, was going to be the wave of the future, no doubt about that. And by then they-- or not long after that, they hired [Bob] Belleville and then Barbara Koalkin and a few people who kind of really got it. So, I don’t know if we could’ve overcome the timing issues. I’d like to think we could’ve, but I can’t swear to it.

Fairbairn: What were the price points you were going out with?

Liddle: Basically, a workstation cost $13,000, and you needed to have a file server. We could make one server do all the function-- I mean, internetworking and filing and all that, mail, but that was about another $10,000. So typically people bought three or four workstations and one server, and so you’re getting up to-- close to $100,000. Now, this was also an era when professionals who were getting Compaq computers with big disk drives and all that, were paying $10,000 for a deskside device. So it’s not quite as expensive as it sounded at that time, but still it was significant.

Fairbairn: Did you have plans to go to microprocessor-based system, 68K? I mean, was that sort of in the product plan?

Liddle: Actually, there was quite a bit of work done to make a Mesa chip and make our own device. You might’ve even been involved in that, right?

Fairbairn: No, I’d left by then.

Liddle: Had you, because I was thinking Conway’s…

Fairbairn: There may’ve been some discussions, but at least I was not personally involved.

Liddle: Anyway, yeah. So, there was looking at a Mesa chip, talked to AMD about would they-- yeah, yeah, “We love your product, and we’ve been using it, but we have a price problem here, but would you like to make this chip?” and so on. So, there was some of that. I remember that the Motorola guys and the Intel guys both came to call on me to say, “Gee, we really think it’d be great for you to get on to a

standard platform," and, interestingly, Bill Davidow came to try to sell me to 186, and I told him, "No, there's memory issues for us, so it won't work." He came back with it 286. I said, "No, that won't do it, either," and then he sent John Doerr with the-- remember the micro-mainframe thing? What was…?

Fairbairn: 432.

Liddle: Yes. John Doerr wants the 432. So, I mean, we had their attention, and if I had stayed on, I would have switched over to the 68000, because by then it was out in the world, and it would've been a much simpler kind of design. The concern was we had a lot of controllers in the microcode of the-- what the hell was the number of the AMD part, the…

Fairbairn: 2900, 29000 or 2900, the bit-slice?

Liddle: Yeah. Yeah, that, anyway, that device sounds right, 2800, yeah.

Hsu: 2900.

Liddle: 2900. That handled a whole lot of stuff. Okay? You couldn't suddenly go and tell the 68000, "Have you ever heard of the ethernet?" There was no good way to do that, because it wasn't micro-programmable.

Hsu: Right.

Liddle: So we would have had to build a bunch of controllers. Now there were beginning to be IC controllers. So it wasn't all downside. And had I stayed on, I would have moved over, without a doubt. But our first effort was to try to get a Mesa chip. And we felt like El Segundo Electronics Center could make the controller chips we thought we needed. And in fact they did eventually make an Ethernet chip. But that's what I would have done, and it is what we did at Metaphor, but at Metaphor, disk drive was on a server, it was just very tightly coupled on the Ethernet. So it was nice, you didn't have any hum on your desk, you know? You didn't have that heat to get rid of. You just had a display and a bucketful of memory, and a 68000. And a wireless mouse, and actually an infrared mouse, and an infrared keyboard.

Fairbairn: I don't know if you're sort of dominated here, what was the winddown of SDD, or after you left, or--

Liddle: It went on for a couple of years. I mean, they came out with a product called the Documenter, which was a Star Workstation, and just the marking engine of the-- what was the name? I can't remember now the number of the little laser printer that we sold that we got made for us, you know? But anyway, that-- I think it was the 3700, we just had an online discussion about that.

Anyway, they took one of those and took all the electronics out of it, and used the electronics from the workstation. So you could either print or edit, not both, but you had a lot cheaper product. And they sold that for 10,000 bucks. That thing called the Documenter. Now the good news about that is, it was a good

price point and people would pay for it. The bad news is there wasn't enough money to pay for the sales rep, okay? I mean, you know, a Xerox sales rep is expensive. Their salary, of course, but all their overhead and all that. And if you got a guy selling $10,000 items, you got to sell an awful lot of them. So the theory was you sold one, and they liked it so much that then they bought a whole bunch of Stars. But that didn't turn out to be the case often enough for it to work. Nevertheless, they went on pretty much the same for a couple years, and then they moved all the software to Sun. I forget what they called it when they did that. But anyway, then they resold the Sun workstations with all the SDD software on it, and did that for several years.

Hsu: I wanted to go back to talk about earlier. So, you mentioned you convinced Metcalfe to come back to help manage. Can you talk a little bit about your relationship with him? You had known him for quite some time before, like you'd met him as a graduate student, maybe?

Liddle: Yep, we met at a graduate student ARPA Conference. That's when I first met him, and a couple years later I came to work at PARC, and he was one of the first people I saw there, I looked up. But he and I are still, to this day, very close. I mean, he was the best man in my wedding, which was held at his house and presided over by Larry Tesler. <laughter>

And you know, he and I-- we and a bunch of other guys-- a group that he started in, hm, '88 maybe or something like that. Called Big Boys Camp. He has an island in Maine with a cabin on it, and we started going there, and built platforms for tents and all that sort of stuff, and still do that. I don't go every year now, because sometimes I have other stuff going on in July. And in February, there's another really nice guy who has a place down in Florida, and Big Boys go down there, too, for a week or so. So I see a lot of him. I'm very close with him. And he and Robin and three other couples are going to Puglia, the heel of the Italy boot, with Ruth Ann and me, to celebrate my 75th. And they went-- what was it a couple of years ago to Greece, and sailing in Greece. And at the time of my 70th, we went to Provence, and they came along. So, you know, despite that they live in Austin, Texas, we spend as much time with them as we practically can, and we're in communication with them a lot. He and I were always very close friends.

Hsu: And can you maybe talk about his role-- you managing him, and then him managing other groups in SDD?

Liddle: Sure, he managed-- how many groups did he have? Oh, at least two or three groups of five or eight people each. He had all the communications stuff, as you might expect. That is the internetworking and the Ethernet stuff. He had a diagnostics team. And he had a team that managed the I/O software and microcode and so on. Many of the first people in those activities came from-- they were students of his at Stanford. That would include Yogen Dalal, Ron Crane, Roy Ogus -- a lot of those guys he had known as students at Stanford. And when he was first there-- we're talking about SDD now, not PARC, you know, when he was first there, he did mostly communications-related stuff and worrying about getting the Ethernet patents through and a lot of stuff like that.

And I think it felt kind of bogged down in big company stuff. And he got offered this job by TTI, which was a Division of CitiCorp to go down there, and essentially be the CTO or VP of Technology for that

company, Technology Transfer-- no, Transaction Technology, Incorporated. So, we went down there. Had a beautiful office with a great view and all that. And stayed for a couple years. But when we started really building iron and getting serious about it, I went down there and stayed with them for a couple of days. We just hung around, went to Laker games and stuff like that. And I just told them how much I wished that he would come back, and how helpful he'd be, and what I thought the possibilities were and all that, and he did! And he's sort of natural at giving people enough rope, you know? He's really good-- he's that kind of manager, if you know what I mean. And he did a good job, really good job. Including some-- dealing with some tough customers. He did a good job. He's like that to this day.

Hsu: I want to transition to talking about the hardware now. So originally the plan was to base it on Thacker's Dolphin design, but then there were issues with that, and then it shifted over to the Dandelion design. Could you talk about that?

Liddle: Okay. There was yet another processor, Dorado? Is that its name?

Hsu: Yeah, Dorado.

Liddle: Okay. And <laughs> we had this wonderful guy, Tommy-- the Chinese guy. I can't remember his last name now. Really--

Hsu: Chang?

Liddle: Yeah, Tommy Chang. And he worked on the Dorado when it was called the D1. And he said to me in the hallway one time, "This will be a real fire dragon!" <laughter> And I said, "What do you mean?" He said, "75 watt! One board!" <laughs> You know, he was really concerned about it. But he had designed some big iron down in El Segundo. And he made a really cool instruction fetch unit for the Dorado. But it was a very big machine that was difficult to cool, so it was like a hovercraft because it had so many fans and stuff in it.

It was originally intended to be for the big laser copier, okay. But it was pretty clear that it was going to be both too expensive and too power hungry to work for that. And the Dolphin we thought would be-- the workstation processor. But I didn't have clearance to do the workstation yet. We were still trying to build one which could be used by the electronic copying people. And that was the Dolphin. Well, the only thing was actually wrong with the Dolphin was more that it, too, just was somewhat expensive. I mean, in a copier-- you relied on a copier to get pretty big gross margins. And you couldn't do that with the cost of the Dolphin, but it was otherwise a perfectly good design. Both of them implemented the Mesa PrincOps, you know, and all that were architecturally compatible.

But I finally got agreement to do the workstation and bring it out along with the other products. And I was worrying aloud about this, and Butler, after one weekend, came back and said, "I've got this idea about how we might eliminate most of the controller boards and all this sort of stuff using the microprocessor in clicks and rounds and all of that." It was very cool! And so that idea, he had a really, really minimalist, spare idea about it. And we couldn't make it work to be quite that cut down. But it was still pretty darn

cutdown. I mean, the Dandelion was pretty minimal and we didn't have heat problems, and we met all the performance requirements. And I wouldn't let them go up from 192 16-bit words-- in other words, 384 bytes, 384K bytes of memory, until the last minute. Because I wanted them to squeeze it down as much as they could. And then I relented and let them go to 512K bytes. And by the way, of course, memory prices were just steadily falling all that time anyway. You know, so by the time it was done, the 512K bytes cost less than the 384K would have a few months earlier. But it was a good design, absent a really cheap microcomputer, and as I've said a couple of times, the problem there would have been the peripheral controllers and stuff anyway.

Fairbairn: So the Dandelion is the one that the Star was based on?

Liddle: Yeah, oh, yeah! Yeah. Everything except the electronic copier. Everything else is based on the Dandelion. That is all of our servers, and the workstation.

Hsu: And how was Wildflower related to Dandelion?

Liddle: If I remember this right, and I might have it wrong. I think Dandelion was the original name given to the design that Butler did. I think, okay. And I think Wildflower was the somewhat modified version that we actually put in the product. I'm not positive about that, but I'm pretty sure. Okay? I--

Hsu: I think there was also a Dandetiger? <laughter>

Liddle: I don't know. After my time.

Hsu: Okay.

Liddle: Ask Robert, he'll know.

Hsu: Also at some point, separately there was the formation of an Advanced System Division or ASD that was trying to commercialize the Alto? So did you see that as somewhat overlapping with SDD's mission? Or was it complementary?

Liddle: I'll take you through it. It's a little bit complicated. Okay. Xerox had a culture of doing probes. Meaning they would bring out somewhat prototype products to see how they were used. To see what users thought of them and how attractive they were, and that kind of stuff. And Jimmy Carter when he came into office in early '77, he was going to change everything in Washington and so on. And so, he had a guy named Richard Hardin, who was-- they had a thing-- you know how there was an Office of Management and Budget? Well, they started to think all that White House Office of Administration, and he was going to streamline Administration generally. He and a number of other guys, all from Georgia. And they came around and wanted to see what Xerox was doing, or what we had or whatever, and somebody-- I think I know all the details of who they were, but I don't think it's proper for me to say so… Somebody said, "Well, gee, you really ought to look at this stuff they're doing, and maybe you can get it."

Well, of course, the next thing you know, we're getting stuff on Presidential stationery, saying, "Well, we want to have Altos, okay. And laser printers and Bravo and all this." Well, ASD was set up to do that. That is to install and study these probes, these early prototypes and all that sort of stuff while we were slow and steady doing this classic development program. That was the original idea, and in fact, it's how it all-- it's how it turned out. And I paid to get some reengineering of the Alto, because we had to use them as development tools and so on. And ASD chipped in on that. ASD built a prototype of a color laser printer, and a prototype of another somewhat faster but smaller laser printer than the one that was being done by the group in ITG. And so they, I don't blame them for it, but they couldn't resist giving this thing to the White House. Well, then, of course, the House of Representatives wants to have it. Okay? And so then they did some for the House of Representatives. So now you got three megabit Ethernet in these places, and Bravo-10, Bravo-X as it was called, running on these things, and of course, I had to tell, "Yeah, yes, but no, that's not what you're going to get from us." "Oh, no, we have to keep-- we already ran this Ethernet! We have to get--," "No, sorry. It's ten-megabit ethernet." <laughs> "Yeah, sorry, it's Star and different laser printers, and all that sort of stuff."

That was a problem, and there was also probes inside Xerox. And so, in a really brilliant move, they put Altos in the Executive Suite of the Xerox Corporation. Where the secretaries can demand, practically anything they want. So, it wasn't really necessary for them to do all that, but they were just trying to execute their charter and get these things in places where they could learn. In some other cases to impress decision-makers and so on. And that's all right. I get that. I mean, that's generally speaking what ASD did.

They did a ton of work to put on this big event down in Boca Raton for the rest of the Xerox world, that is the Xerox International Partners to come in and see and be inspired about how-- what Xerox would do going forward. So, they had to borrow a bunch of equipment from us to have enough to do it, actually. But they had a couple of different laser printers and workstations and so on. And it had a very bracing favorable effect on the management teams around the world. But it was after that, there wasn't much of a point to having them duplicate the stuff that we were doing. A lot had been learned and they had shared a lot with us. And they had some very good people in that organization. But it was basically decided to close it down, because it cost money to keep it running and yet they didn't have any more an urgent charter, and a bunch of good people from there came and worked for us in SDD. So our time scales were different, for sure. And the only thing was ever a problem was that some of these high-profile probe customers were demanding improvements and didn't make too much sense to keep developing those old platforms. Or they wanted us to do things to be compatible with them. Well, we couldn't afford to do that. But otherwise, I wouldn't say that there was conflict. No.

Hsu: Maybe talk a little bit about the development of the user interface?

Liddle: Sure. There's a lot to that, but the very first use that I ever saw of icons was done by Bill English on his post screen. He had a little picture that said, "Hard copy," and a little picture that said, "File folder," and stuff like that. They weren't particularly artistic, but you got the point. And you pointed to them and they would open and so on. That was the first use of icons like that that I ever saw. Now the LRG people were also very into icons, and for all I know they might have done something with it sooner. But that's

what I remember is seeing Bill English do that. The NLS used tiling to separate windows. It was all text and you could open a window and feed your camera into it, too. But, they were tiled. And tiling like that was the path we were on for POLOS. I remember you and me sweating away over getting a video picture into a <laughs>--

Fairbairn: Oh, yeah!

Liddle: -- into a screen. But the LRG people, they're the ones who said, "No, no, no, you want overlapping windows. You want to be able to hide them and bring them up," and so on and so on. So that came from LRG. Dave Smith, David Canfield Smith, did a lot of work on icons, and had done it for quite a while. He was in a Smalltalk shop and he did a lot of stuff early on, and he took a more, I thought, more nuanced view of icons. In other words, they weren't just sort of square hotspots with a name. You know, but they should have some semantics to the picture.

But as we were starting into Star, Charles Irby, who I had brought over from SRI, was running the User Prototypes Group-- Charles Irby, David Smith, one or two other people, maybe Linda Bergsteinsson, I'm not sure-- one or two other people-- wrote a really nice paper, which I'm sure you have here, called the "Designing User Interfaces." And then it was later published in the, oh, *NCC* or *Fall Joint Computer Conference* or something. But it described the underlying model where you had the three things were important. The information display, the command invocation and the user's conceptual model. And those were the guiding principles that were talked about in the paper.

And when we made this giant, 200-page functional spec it was all driven by that. And we had pictures of every screen view you could imagine in there so that there wouldn't be-- weren't mistakes. It was a North/South team that did all the-- well, we had PARC people, SDD North people and SDD El Segundo people, all on the team, and it was all carefully argued out. The important things in the Star User Interface, the idea that you never saw-- you didn't see an application. You saw the objects that it worked on. In other words, the documents on your desk. You didn't open a word processor, and you had graphics on your desk, but you didn't have a program that did it. In other words, that was all submerged, and it was about pointing and clicking and progressive disclosure. Meaning if you selected something, it never would show you a command-- it would never make available a command that didn't make sense in that context.

So, you opened a text document, you could select a paragraph and it would offer you a bunch of commands like "Justify," so you can justify these paragraphs. But if you selected a bar graph that was in that same document, it wouldn't show you "justify," okay? So instead of having a long ridiculous skein of instructions, or a 20-entry pull-down menu, you got only-- you right-clicked and got the commands that were meaningful in the current context.

That was a very big deal. And nobody else had really thought that through very much. In other words, they always thought it was okay to have gratuitous commands there that couldn't really be used. And we were real careful about that. Also you never-- because it was a metaphor-- that is a metaphorical type user interface-- you stuck as closely as you could to the physical world properties. What I mean by that is if you put a document into a folder, and you put the folder into a file drawer, that's where it is, man. If

you're going to go get it, you got to go all the way back to get it. We did have the ability to make only one copy of a document and have it available in several places. So, if you made this one document and it was in three file drawers, its iconic image in those other file drawers was gray, so you knew that this is just a ghost, just a link, you know? And we tried to keep everything intuitive, that is, so it felt like what you would be doing if it was a real desktop, and a real file drawer and so on and so on. And most of that has held up pretty well. Some of it's a little tortured now. But generally, that approach to user interface design has been pretty good.

Hsu: Could you talk a little bit about the operating system?

Liddle: The operating system?

Hsu: Mm hm.

Liddle: Sure. Pilot. It was a thing of beauty. I gave a talk once in which I said, "It was designed just as operating systems were going from the Baroque to the Rococo," and I think generally that was true. And we set our face against that resolutely. That is, we said, "Nope, we're going to do a modern operating system with everything that's known up to the minute that will help, and nothing extra. Nothing gratuitous."

And that worked. Not everybody understood why we included all the things that we put in. At first, some old system programming-type guys would say, "Why do we need co-routines? Why do we need ports? Why do we need that stuff? All these things that come from Mesa?" and so on. But they all actually had justification. There were real reasons for them, atomic transactions and stuff. So, it had really good security, *really* good protection. And it was a virtual memory system, of course, and it made very good and very clever use of it. One of the-- well, that's a different topic, I'll cover that later, but the-- it was a really good modern operating system. There were several really good papers have been written about it, of course. But this was back when people thought that writing an operating system was supposed to be a death march. Do you know what I mean? And you know, you had that nice guy from IBM at-- he's a professor at UNC.

Hsu: Oh, Brooks.

Liddle: Yeah, Brooks. He wrote "The Mythical Man Month" It was all about how terrible and hard it was to be build OS/360, and about how the guy got fired because he used-- wasted 28 bytes to handle Leap Year. And those were these enormous big things that did everything! Well, we knew what the software was we were going to run, and what we were going to need. And so that's what we provided for. And we provided really well for that, and nothing for other stuff. Do you know what I mean? And of course, it made sense. We weren't selling a general-purpose machine, but Pilot was robust and elegant operating system. Mesa, of course, also was a very modern, really good programming language. And by the time we'd been through a few iterations of it, it was tight as a drum and really good.

One of the things that I was always very proud of was that we Huffman coded the instruction set. And what I mean by that is you would generate, you know, you had source code. It would generate some

instructions, okay? And some of them were really elaborate instructions, too, like "RIXELP, read indirect external pointer," <laughs> and stuff like that. Well, what we did was look at the compiled code and say, "Okay, what are the most frequent? And then the next most frequent? And the next most frequent?" And we coded those with successively larger word lengths, because they were going to be rare. And the common ones were really tight. And we got, instead of 16 bits per instruction, we got down to 10.5 bits per instruction, on average. And that gave us a lot more memory to screw around with, and to use for other purposes. So, the system engineering of that product was really good! And I mean the Mesa and the PrincOps and the architecture, product architecture design and Pilot worked together. Fit like a glove!

Hsu: Okay. Could you talk more about the decision to use Mesa? Because there were other languages that had been used on the Alto, right? Like BCPL, Smalltalk, Interlisp, but Mesa was the one that Star went with.

Liddle: Yeah, well, we spent time with it, we analyzed it. We actually spent time on it in the POLOS Group, too, on those questions. Here's the deal. Smalltalk was-- I mean, we all liked it, but you couldn't make it run very efficiently, very fast. Understandably, I mean, Christ, it did dynamic inheritance, and all kinds of complicated stuff. So, for performance reasons we couldn't use that.

BCPL, if Evel Knievel were a programmer, he would use BCPL. <laughs> BCPL was made to allow you to do *anything*! In other words, writing a high-level language, but still take any risk you wanted to. Like, for example, pun between integers and addresses. You could jump into the middle of a text file and start executing it. Okay, like a piece of code. You could fabricate instructions on the fly. In fact, in a Nova, you fabricated I/O instructions by adding integers together that gave you this weird-looking ugly thing and then "psht" suddenly your disk drive was running or whatever it was. So BCPL had no protection. Deliberately. I mean, it was a system building language. By system, I mean it was for use to build a new compiler for a new computer and stuff like that. So, Mesa was there. Really good guys were working on it, I mean, Jim Mitchell and Butler himself worked on it quite a bit, and Ed Satterthwaite, and Dick-- remember that guy? Dick-- really nice guy. From the South, I think.

Fairbairn: From where?

Liddle: From down South someplace. Anyway, it was a good team, and they worked on it hard, and they built good tools that worked with it and took advantage of it. So, C was the other choice, okay, then. And that should have been the grade received by whoever wrote that language. <laughter> Because it just-- it wasn't that great. It was okay, all right? The Bell Labs guys, who were writing UNIX, they wanted to knock something out that they could run on the PDP-11. C was perfectly decent, but similar to BCPL in the sense that it didn't implement type calculus, or any real protection.

Fairbairn: Does Mesa survive anywhere these days?

Liddle: Yeah, it's basically Java is Mesa. You know? I mean, not to hurt anybody's feelings, but <laughter>-- no, it is! You know, Jimmy Mitchell went over there, and they already knew all about it when

they did Oak, which is-- used to be the old name of Java. They implemented all these features from Mesa, oh, yeah.

Hsu: How did the Star name come about? And also, the number 8010?

Liddle: Okay, the name came from the fact that <laughs> in one of the reorganizations, we got a new boss. Oh, I had his name right on the tip of my tongue. Really nice guy. Former IBMer. And Spinrad was now reporting to him. And he was a sailor. And he sailed the Star class boat. And so just to see if it would appeal to him, we're just calling it Star as a code name, it wasn't going to be the product name. But--

Fairbairn: Placeholder.

Liddle: Yeah, "professional workstation" was a little too much, you know? And we knew people would call it Star. So we didn't worry about the fact that 8010 isn't that easy. It was the 8000 Series. So, file server was 8020, and the print server was 8030, and so on. And so, it was the 8010, but it was always called Star. What was that guy-- oh, I almost thought of it. First name was Dave. Ah, that's a shame for me to forget names like that. He was such a good, solid guy, too. Anyway.

Fairbairn: Kearns, it's not?

Liddle: No, not Kearns. He worked for Kearns, of course.

Hsu: During one of those reorganizations, the SDD was originally Division, and then became Department?

Liddle: No.

Hsu: No?

Liddle: No. It was always a Division, and always a Department in the Division.

Hsu: Oh!

Liddle: They just said, "Well, what do you want to call your Department?" I said, "I'm going to call it the System Development Department," so they said, "Oh, you're going to take the whole Division, huh?" I said, "No, you can have System Engineering, you can have System Requirements and Planning. I'm System Development!" Okay? And everybody said, "Okay." <laughs> So SDD, always meant System Development Department, and then it became System Development Division. And then when Massaro bought us out of our servitude, it became the Office Systems Business Unit. So I was head of the OSBU, and SDD was still SDD. But it was now Department, or as it always had been, basically. All the people you know or ever talked to all were in the System Development Department.

Hsu: Hm, okay. So, it was always both the Department-- there was always a Division underneath the Department.

Liddle: Yeah. No, a Department underneath the Division.

Hsu: The other way around. <laughs>

Liddle: Yeah.

Hsu: Okay. So, it's safe to say it sounds like that had Massaro not become a champion for SDD, the Star may never have shipped.

Liddle: Could be! Yeah.

Hsu: So, we talked a lot earlier about the price point and the-- how difficult it was to get it out the door. Was it marketed towards the right users or the right segment? Who were supposed to be the users? Was it secretaries, or was it executives, or professionals?

Liddle: Yeah, professionals. Not secretaries, not executives. Secretaries and executives used it, of course, but that wasn't for whom it was designed.

Fairbairn: The name comes later, but sort of desktop publishing? I mean, people doing high-end document kind of work? Is that-- I mean, people--

Liddle: The engineers.

Fairbairn: -- that really used desktop publishing.

Liddle: Yeah, engineers writing specs, and contracts and stuff like that. Writing technical papers, yeah. That was--

Fairbairn: Did it find its way to lawyer's offices?

Liddle: Yeah, a lot. A lot.

Fairbairn: Was there a market that you didn't envision that became a significant user?

Liddle: <sighs> I guess I don't know the answer to that. It did surprisingly well in the aerospace market. And I think what happened is Martin Marietta produced some beautiful report <laughs> that went to the Air Force, and Boeing said, "Where the hell did that come from?" And the next thing you know we're in Boeing and Northrup Grumman. And I'm pretty sure that's what happened there. And we had never really thought about that. But they were classic users. A lot of people who did manuals and things like that.

Fairbairn: Yeah, I can imagine.

Liddle: Were big users.

Hsu: What were the biggest challenges for you in managing SDD?

Liddle: Oh, you know… It was mostly stabilizing its strategic position in the company. That was the biggest challenge. The people were great! The reputation of PARC was such that people would come and hope that they might find some way into the research lab, and they would get sent over to me and they would meet all these other smart people that had once been in PARC… So there was a lot of energy around that. And that even worked in Los Angeles, in El Segundo, because they were attracted to what they were hearing about Xerox PARC and then what they were hearing about SDD.

So, hiring people wasn't that hard. Managing was not that hard. In the sense of people hitting their schedules… When we had the resources, we hit the numbers. And that was because we did have a lot of good managers. When you're part of a big company, they do things very broadly sometimes. So, they'd suddenly say, "Okay, we have a hiring freeze now." And the problem is here's all these different businesses and for some of them doesn't matter, and some of them are really hurt by it. Or, "We've got to find, you know, a hundred million dollars this year out of spending, so we're going to--"

Fairbairn : "Cut everybody."

Liddle: Yeah, right, you know? It's nothing new. Everybody faces that. But all that I would say was that was probably the most difficult part. I think the other hard part, too, is the salesforces… We just didn't match their model. Either the Word Processing guys, or the Electronic Printing guys, or the Copier guys. It just wasn't a match to what they did. Now, that doesn't mean that they didn't try really hard, and some of them sold a lot of iron. Some of them did a very good job.

But I'm just making the point that I think the only salesforce we could get our hands on was the Office Products Division, and I'm not knocking it, but I'm just saying that we didn't have a competitive organization to go up against some of our competitors -- from the point of view of a trained salesforce. These people were selling very different stuff. And then bang, we just dropped them in, sent them off to Leesburg [Xerox's corporate training facility] for a week, and, "Okay, you're trained. Go to it. Here's your quota." Not that we had any choice about that. But that was the discouraging thing that caused Massaro and me eventually to leave, was to realize that we were now going to have no say-so over the salesforce and how they were prioritized and trained. This is probably a good point for me to say something else.

Hsu: Do you want to say on the record, or off?

Liddle: Yeah, it's okay. It's just related to that topic we just were on. I particularly wanted to take our architecture… I wanted to take it further into computing. That is data management and … there was all kinds of stuff that I felt that we could and should do. And Xerox did not want to do that. They said, "No, we got out of the computer business. We've let you do this, because this is about printing and documents

and so on, and that's okay. But we're not going to do it. And by the way, anyway, we're folding your salesforce into the larger salesforce."

Well, from looking back at it now, they probably did the right thing. They fought off probably two of the scariest companies in the world, IBM and Kodak, and they beat them both in the copier/duplicator business because of how they invested. And they took on the Japanese and forced them only really onto the desktop and a few things like that. That is, the company was in real trouble, and they turned it around in a big way, and they did that by saying, "Nope, we're going to stick to our knitting now. Yeah, we'll keep this cooking on the back burner, but only to the extent that it impresses our printing customers." I can't say they were wrong! They did save the company in that way. And if I'd have given them 50 or $100 million dollars in revenue in the first year or two, "fft!" that wouldn't have meant anything. So, I have to say that with the benefit of hindsight, senior management probably was right to hunker down the way they did, and they certainly did it successfully.

Fairbairn: You mentioned some numbers there. Could you put some numbers around SDD in terms of peak revenues, profitability, you know, just summarize what the--

Liddle: I don't know. I don't know much of that, because most of it happened after my time.

Fairbairn: Whatever time that you have.

Liddle: Oh, yeah, well, in '81, I don't know, we did probably $15 million or something. In '82, in the tens of millions, but that's around when I left. So, they were just getting rolling really. And then that salesforce thing happened, and then the numbers were all submerged into the big sales numbers.

Hsu: Right.

Fairbairn: How many units? How many workstations got out there? Tens of thousands? Thousands?

Liddle: Certainly thousands, without a doubt. Yeah, I don't know any more accurately than that.

Fairbairn: Yeah, I just wanted to get a scope.

Hsu: Did the work on the 6085 begin while you were there, or was it after your time?

Liddle: It was after my time.

Hsu: Okay. What was your reaction to the IBM PC and then later the Lisa and the Mac?

Liddle: My reaction?

Hsu: Yeah.

Liddle: Well, the IBM PC was what it was! I mean, the only personal computers out in the world were hobbyist computers, and then Apple started selling a completed computer that you didn't partly assemble, right? And that was pretty much the story until IBM Entry Systems brought out the IBM PC. And that gave people confidence that, "Okay, there is somebody behind this. There's engineering and manufacturing and quality control and all that sort of stuff." And so, it's not a hobbyist's product anymore. There were already people using their office supplies budget to buy Apple IIs and stuff like that. And by the way, Xerox immediately -- Massaro, if you told Massaro a good story, he would jump on it. And there was this guy-- he was actually a draftsman down in Dallas, can't remember his name now-- and he said to Massaro, "Look, if you want to have a personal computer, you know, we can do one in less than six months." And they got-- they took the screen technology from-- not from Star, but from the word processor. And otherwise, instead of green screen, they had a white screen. And CP/M operating system, and an 8080 and put it on a board, and it was called the Xerox 820. And it sold a whole bunch of them until the IBM PC came out. <laughter> And then that was game over for any CP/M machine or any machine that wasn't utterly IBM compatible. But you know, when I saw that, I thought, "Well, there's a big gap here, from that to a professional workstation. I said to myself, "This will probably kill the electromechanical word processing business," which it did.

In the 1981 NCC is where we announced Star. And Steve Jobs and some of his team came and sat in the booth over and over and over watched the demo of Star again and again and again. And of course, he already knew-- he had seen lots of Altos and all that sort of stuff, but he began to think, "Well, okay, this is a serious office product idea here." And when I first saw Lisa, I thought, "Eh, this isn't going to do it," you know? "It's meant for the office, but it's not really fast enough, and it's not really easy enough to use and switch between apps and all that sort of stuff," which turned out to be true.

The Macintosh was supposed to be a game machine. And two Xeroids who had gone over there, <laughs> Bob Belville and Barbara Koalkin, came into Steve, "No, no, no, if you're going to do the Macintosh, thing, you should do it for the office! You know, I mean, the game machine business changes every year or so." And it was razor thin. They had pre-sold a bunch of Macintoshes which kind of saved them. Sculley was really smart about that, because when they launched it, people didn't know what to think about it. And it sort of blundered along for a while, and it was still pretty underpowered, really. But gradually, it got real disks, and instead of AppleTalk, it got a real network, and so on and so on.

And they managed to keep the price low enough that they could sell it and make a buck. And Xerox, it cost a couple thousand dollars to enter an order in Xerox, because of our structure of selling great big valuable machines at really high gross margins and so on. So all the stuff that you use, if you've got a retail business, we didn't even begin to have. We had to sell it through a direct salesforce. But Apple had never had that, and didn't let it get in their way. So no, I knew that the Macintosh was a good start to kind of a product family that they would produce. Turned out that they got off track a little bit, and focusing more on workstations and all that, you know? But--

Hsu: Can we talk about Metaphor now?

Liddle: Sure.

Hsu: So you decided to leave Xerox in '82, and then partner with Massaro?

Liddle: Yeah.

Hsu: Can you talk about sort of the run-up to that decision, and then starting the company?

Liddle: We were in Connecticut on-- we were told that salesforce was going to be moved. And then driving on the way to the airport, and they had also told me that they did not want to go more deeply into computing. And on the way to the airport, you know, Massaro said, "Well, I don't know. Why don't we-- I'll move back to California. Why don't we just start something? You know? Because clearly, they're not going do this. We can probably do a partnership with Xerox of some kind." And I liked that idea. I said, "You really think you can do this in a little startup company?" He said, "Oh, yeah, can do *anything* in a little startup company!" <laughter> Because see, he'd been very successful at Shugart, you know, but to me it seemed, "Ooooo," you know, that's <laughter>-- Anyway, he talked me into it. And I did like the idea.

So, we spent a couple of weeks… He moved back to California, and we spent a couple weeks working on a business plan, a rough idea about Metaphor… And we took it [to] Xerox. The idea being that we would at first resell the Star, but with a different suite of software. And then, meanwhile we would develop a new hardware platform, which we would build for them also. And we went and visited Dave Kearns and talked to him about it and told him what we were thinking. He said, "Okay, well, the XDC guys will have a look at it, Xerox Development Corp." It [XDC] was run by Abe Zarem, former head of Electro-Optical Systems, and a very wealthy entrepreneur himself. He hired a bunch of guys and they were doing venture investing, supposedly building a portfolio of office system like companies for Xerox. Anyway, they looked at our deal and they said, "Ohhh, I don't know. This sounds like you guys want too much money, and you know, we're not so sure that this is really a good area to go into business." And to be fair about it, I think it was probably a little scary to go back to Xerox for them to say, "Yeah, these guys are right, we should be doing more in the computer business."

So we wound up not dealing with them, but Don Massaro had made a lot of money for Bill Hambrecht and Stu Greenfield, and all these venture capitalists at Shugart. And they had a lot of confidence in him. So, we went and raised some money, and we didn't find it all that hard, really.

Fairbairn: What was the positioning of Metaphor? What was the--

Liddle: I would show people a little bit of film of the Star, saying, "Look, you see how this is. What this system is like, and we would like to do a version of this that is intended for data users…. And people that are like that, that have to get data out of mainframes and are sick of waiting in line for a priest of the IT community to generate a report writer for and all that stuff. That's what we want to do. We think we know where there's a lot of those people, industries that really need help and where we think we could take this product. And we have an idea that to make the thing inexpensive, we'll use this local area network/client-server architecture, so we don't need all the heavy-duty peripherals in the workstations. But we can do all

the computation there," and blah-blah-blah. And people just liked the idea. They had confidence in me technically, and they had confidence in Don as a management guy. So that's how it happened.

Fairbairn: And did you develop a hardware product, or--

Liddle: We did! Oh, yeah! We developed--

Fairbairn: And it was 68000-based?

Liddle: Yep! Yeah, we sold a lot of them. And then eventually, when IBM PCs were good enough, which is sort of funny, but it's true… The first thing we did was move the software -- we were kicking IBM's ass with our product. <laughs> And they wanted a product like that. So, we did a version for them that ran on their hardware, that is the servers were IBM hosts and IBM PC workstations. And we made a version of all our software for them.

And then we also put our software onto other platforms like Compaq and so on. And we spun out our hardware business to Flextronics, because there were still a lot of customers out there that would buy more of ours, but it was going down, you know what I mean? So, they had that tail-end business. And then a year later, IBM acquired the company, because we were in so many of the important accounts, and they were worried that somebody else-- probably Microsoft they were worried about-- would come along and scoop up the company, you know?

Hsu: So you were a VP at IBM after that for a bit.

Liddle: Yep, for a while. Main thing that I was concerned with there was to make sure that my team, my people were properly settled into -- that they were understood as to what they were good at, and what they could do, and that they all got a good hearing, a good position at IBM. Which did happen, too. A bunch of them are still there!

Hsu: Oh, really?

Liddle: Yeah!

Fairbairn: So, it was just a transitionary thing?

Liddle: Yeah, yeah, I only stayed until the following spring, and then I was just about to go to work at Kleiner Perkins-- I was going around with Floyd Kvamme, and visiting some of his companies, and we were talking about doing it, and because they had been investors in Metaphor, you know? And then Paul Allen called me up and said, "Well, I'd really like to start a Research Lab like the one you had at PARC, only well, we can start new companies to take things to market, instead of doing them for one big company.

Hsu: And that was Interval?

Liddle: Yeah, Interval, yeah.

Hsu: So that started in '92, and then you left in '99?

Liddle: Well, yeah, I left right at the end of '99, I mean, 2000. It was on-- you know, I turned 55 then. I thought, "Okay, well, I made some money, I'll just take it easy." And I learned to fly my new jet, read a big pile of books, and in six months, I was a wreck! <laughter> You know?

Fairbairn: So but was Interval, I mean, was it successful in spinning out some companies?

Liddle: Yeah.

Fairbairn: What was the good news/bad news about that venture?

Liddle: Well, we did not make back all the money that we spent, as is always the case with research. I mean, you have these many things that you do research on, and then these many things that you try to commercialize, and these many that are successful. So you have to do research for some other reason as well, but we did succeed in spinning out, and selling some companies. We did a bunch of licensing. So we did okay, but we didn't earn back all the money that we spent.

Hsu: And so, after Interval, you actually did become a venture capitalist.

Liddle: Yeah. Yep.

Fairbairn: How did you find that experience vs. an operating position?

Liddle: <sighs> The good thing about venture capital is it's kind of like teaching, or coaching when you're working with a company. And that part's really good, and really enjoyable. Saying “no” to smart people is really awful. You kiss an awful lot of frogs to find a prince. And so in looking at all these companies with smart people doing their very best to convince you of something, you know? So it's a little painful. The good thing, though, is you create a bunch of jobs when you do get a company going, and make some money for your limited partners and all that. So all things being equal, I probably enjoyed myself more in operating jobs. But venture capital kind of expands your horizons. Because you look at a lot of stuff you--

Fairbairn: You see a lot of different things.

Liddle: Yeah! That you otherwise never would. So I think that's kind of kept me young. I think it was good for me to do that. I did it for a long time. So I enjoyed that. I still have a couple. <laughter>

END OF THE INTERVIEW

