Oral History of Barry Cox

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Katz: We have Barry Cox with us, one of the pioneers in the semiconductor industry going back to a number of the early well-known companies and some later ones. Barry, I'm Jeff Katz, we're going to be interviewing you for a couple hours here about the arc of your career.

Cox: <laughs> All right.

Katz: Welcome to the Computer History Museum. Let's like-- we like to start with a little bit about the context which brought you to where you are, that is how did you grow up? What kind of family were you in? How were you educated?

Cox: Well, I grew up in the Midwest, Kansas City, lived there 'till I was 18 years old. And just like any youth, I think growing up had no idea what I was going to do.

Katz: What'd you like to do when you were a kid?

Cox: Play a lot of games.

Katz: <laughs>

Cox: You know, I was fairly athletic and at the high school level and in fact, that's how I ended up in college, 'cause I was a recruited athlete.

Katz: What was your sport?

Cox: Football.

Katz: Ah-ha.

Cox: But that was something to my advantage because a lot of kids, you know, coming into and out of college, they have to choose something and many times I'm sure it works out well, sometimes it doesn't. And ending up going to the Air Force Academy as a recruited athlete, your first few years in your career are fixed, you go in the military.

Katz: Yeah.

Cox: And it turned out to be a very, very influential part of my life that-- why, how I got here.

Katz: Well, all right, in high school before you got to the Academy, did you have any particular strengths or things you hated doing that would've put you into a certain college or not?

Cox: Not really, except I always believed, and I can go back into thoughts in high school, I thought what I wanted to be was a lawyer.

Katz: Mm-hm.

Cox: Absolutely. For what-- you know, I took a few courses having to do with legal protocol, etcetera, and really enjoyed it. And I was convinced that I was going to become some type of lawyer.

Katz: Lawyers-- law schools usually don't have athletic teams, do they?

Cox: Huh?

Katz: <laughs> You know, University of Chicago Law School, it doesn't have an athletic team.

Cox: Well, you know, usually even with lawyers now today you go to undergraduate work.

Katz: Well, yeah.

Cox: Of course, Stanford and some do. But, by the time I got out of high school and honestly….many that know me don't know the reason I ended up at the Academy, I had no military background in my family. No one in my family, my father, my grandfather had ever even served in the military. My father was at a unique age between he was too young for the First World War, too old for the Second World War. But it was literally the best offer I got from a standpoint of education from a scholarship. And, of course, that changed everything because that's what really dictated engineering. I didn't mind the thought but, you know, high school in our time, yeah, you took some science and you took some math, but there was really no concentration on computers, 'cause I think you graduated a place the same time I did, 1960.

Katz: I was '61, but yeah.

Cox: So yeah. So it's the same time. And there was no concentration on, you know, computers or solid state [devices] at all.

Katz: Not in high school.

Cox: And so the thought of being an engineer really didn't cross my mind. It could have happened. But when I got to the Academy at that time, [it had a] very fixed curriculum compared to a normal university those days. And we all came out with a Bachelor of Science in Engineering and that's kind of what dictated my direction.

Katz: So it was a primarily engineering oriented education that everybody there was an engineer?

Cox: Oh, everybody that graduated graduated with a BS. Some had related-- you know, courses in other areas, but everybody graduated with a BS.

Katz: Mm-hm.

Cox: Which is that's not true anymore. It was just like West Point in Annapolis. There was a very fixed curriculum in the whole eight semester, four year program. There were probably five or six elective classes. That was it.

Katz: Well, what were your favorite classes there?

Cox: You know, interesting, some of the elective classes, like there was a lot of work in legal and administrative and economic areas.

Katz: Yeah.

Katz: And the engineering, that was just there, but I really enjoyed some of the elective courses, although you knew where you were going to end up.

Katz: Yeah.

Cox: And that's another thing that kind of drove me to where I think my career ended up because by the time I got out of the Academy I was-- wasn't qualified to fly. Back in the day when I went there, you had to be, you had to pass the flight physical, you don't anymore, they realize they need people in other areas. But by the time I got out I no longer could pass the physical because of football.

Katz: Oh.

Cox: And I ended up becoming an electronics officer and went back to Hanscom Field as part of the Electronics Systems Division of the Air Force Systems Command.

Katz: I see.

Cox: And that was the first real experience, particularly in electronics, because I was a system electronics officer for four years in the military working on big system communications systems.

Katz: Where were you deployed? The whole time at that one place?

Cox: Bedford, Massachusetts, right outside of San-- and I spent a lot of time in Vietnam because we were doing a lot of the over-the-horizon radars and lot of equipment. We were actually contract for, contracting and making sure it was installed and accepted. But I was based the entire four years, I was an officer, in Boston, outside of Boston in Bedford, Massachusetts. Not a bad duty.

Katz: Better than getting shot at.

Cox: Yeah. That's right. That's right.

Katz: So you had to do your four years. Were you anxious to get out or did you get pulled out?

Cox: You know, I wasn't anxious to get out, but again partly because of my background as a youth living at home, I had no thought or experience with being a career officer. I hadn't even applied to the Academy. I never spent any time in high school thinking about why do I want to go to school here? They came to me and recruited me. And so I just never even after graduating thought about really being a career officer. So actually, the thing that I did while I was in school back there, I went to night school and got a Master's in business, so I had a lot of good experience in engineering and system development, but was able to get the Master's degree at night school while I was there, so the best of both possible worlds.

Katz: Okay, so you end up learning some administrative stuff and technical stuff in the Air Force at the Academy. And your time was up in the Air Force. What happened next and how?

Cox: Well, you know, the main area I worked in electronics was satellite communications. And I was really-- this was 1965 to 1969, really in on the start of solid-state electronics. Worked very closely with Sylvania and their technology, both in communication systems, but in solid-state electronics when it was just really starting.

Katz: The Sewell[ph?] program?

Cox: Yeah.

Katz: Yeah.

Cox: And--

Katz: I was a customer for that.

Cox: Yeah. And, you know, when it came time that I made it a decision I was going to leave the service--

Katz: Yeah.

Cox: -- and I was going to graduate, I graduated from Boston University in June. I think it was something like June the 9th and I was discharged on June the 11th.

Katz: Wow.

Cox: So in that spring, I interviewed with several different corporations, but I was really focused on TI and I got a job with TI. And--

Katz: Is that because of your experience with electronic equipment?

Cox: I wanted to get into-- I absolutely wanted to get into a semiconductor outfit and I got the chance to join TI in the very, very early days of bipolar TTL.

Katz: Who hired you?

Cox: This is an interesting story. Jack Carsten.

Katz: I know, Jack.

Cox: We all know Jack.

Katz: Yeah. Well, I brought that question up intentionally because it was Jack who said, "You got to talk to Barry" when we did his oral history.

Cox: Yeah. Well, you know, he was one of the semiconductor marketing managers when all semiconductors were centralized, not divisionalized at TI. And when I went down there in the spring of '69, before I was discharged, they were breaking up semiconductor group under at the time Morris Chang. And they put a digital group-- bipolar digital group and an MOS digital group in Houston. They left the ECL Group up in Sherman, and they left the RTL and analog group in Dallas. And Carsten was going with the digital bipolar group as marketing manager to Houston.

Katz: He told me because no one else wanted to go.

Cox: It's true. You know, and that was an advantage to all of us. A lot of these guys, they were longtime Dallas guys. They, what's in it for me? They had kids, they had kids in school and that was really the reason. They gave me a choice says, you know, "You can choose any one of these groups. Where do you want to go? You want to stay in Dallas? Because I went and interviewed when they were breaking it up and they said, "Well, we want to offer you a job in semiconductor marketing. Where would you like to go? We're going to have some RTL and some analog here. Bipolar is going to move to Houston. We're going to move ECL to Sherman". And I really chose to leave Dallas because I said, "You know, there's not going to be any longevity in front of me….

Katz: RTL? Yeah.

Cox: And TTL was clearly the first real standards coming up. But that was-- but the biggest reason, I didn't even know Jack. I interviewed with him after I had interviewed, been made an offer and accepted the job. Then they said, "Well, job's not what you're going to be. You're not going to be in centralized marketing anymore. Which one of these divisions would you like to go to"?

Katz: But was it your intent to be in marketing as when you were pursuing TI?

Cox: Yeah. Absolutely.

Katz: You didn't want to do anything with the technology?

Cox: Well, I wanted to stay abreast. But the idea of developing product and interfacing with customers and defining product from an application standpoint was very appealing to me as compared to working in a lab or, you know, developing integrated circuits. Whether from a process or a product standpoint. I wanted to deal with animate objects. I wanted to deal with the customer.

Katz: So what was your first assignment?

Cox: Well, I was in the TTL group and I had a dual responsibility of working with some major customers, but at that time helping define where we were going to take the product line. I mean, you know, at that time we talked about SSI, MSI, and LSI. And SSI was anything less than 10 gates, MSI was up to 20 gates, and LSI was anything above 25 gates. <chuckles> That was big.

Katz: Yeah.

Cox: So--

Katz: Did the Yellow Book exist yet? I don't think so.

Cox: No. No. Not at all.

Katz: Yeah.

Cox: No. So, you know, it was really a wide-open, what are you going to do with this technology? We've got this bipolar now. People were maybe just thinking about MOS technology, but certainly not CMOS. And no one believed that CMOS or an MOS derivative could perform at the same performance level as bipolar then. So there was a lot of application definition involved in my first job as a marketing engineer and a lot of customer interface. Because you think back at that time, we took the job that used to be the designers out of the system. They used to build those. We were now selling the chips that were what they used to design. And so, there's a lot of customer applications even before the microprocessing like, what do I do with this thing?

Katz: So, wait a minute, there's two aspects to the application, one is teaching them what to do with it and the other one is finding out what they need to have done, so you can make that chip for them.

Cox: That was a single position at TI at the time. We went out and talked with customers, we went out and helped the customers work with the products we had and showed them how to best efficiently use

them. But in doing that, part of the conversation always was, "Well, where do you think this technology can go? What do you need"? And--

Katz: I presume that--

Cox: -- it was right when you do it in one person.

Katz: I presume that's what found its way into all the various MSI versions.

Cox: Sure. Sure. 'Cause, you know, the biggest problem in those days was, we had the technology. We could-- we define, we have enough gates to define the functionality, but what do you do? There was no single application large enough. So what the limiter was, can I define a circuit that'll have a broad enough use that I get to pay back on my money, on my development? And so that's where I started.

Katz: Okay. How big a group was it?

Cox: Oh, Jack probably had…. Actually at that time there was a manager between Jack and myself and Jack had probably about a division marketing group of about 25 people total. Pretty good size.

Katz: Yeah.

Cox: We developed that into, you know, by 1975, '74 when I left, that was a worldwide hundred million dollar business just in TTL 54/74.

Katz: Yeah.

Cox: It's a big business. Very large business.

Katz: I was one of your customers. You're welcome. <laughs>

Cox: I'm sure.

Katz: We had a sales guy, a Texan, who you may have known, it was a sales guy in South Florida, Bill Ruth.

Cox: Oh yeah.

Katz: Yeah.

Cox: Absolutely. I knew Bill well.

Katz: Yeah. Bill and I got together a lot and I ended up buying a lot of stuff from him.

Cox: Yeah.

Katz: Yeah.

Cox: There was a name I would've never thought of, but I knew him well. Yeah.

Katz: Yeah. All right, well, so how long were you in that function? Or did you have other jobs later at TI?

Cox: I got promoted. I started actually, out of the Air Force. Although, I had an advantage 'cause I had had a lot more experience than most college graduates in totally related field. But I started as an individual contributor, and when I left TI in 19-- right at the end of '74, a lot of things happened. TI was growing like a weed, like the whole semiconductor industry, and in fact, Jack had left bipolar, was over running the MOS division at TI--

Katz: Yeah.

Cox: -- before he joined Intel. And I had taken over as marketing manager for TTL. So I moved up through the organization and, of course, TI was heavily divisionalized. But I was running the marketing group for bipolar for TI at the end of '74.

Katz: At TI, I'm sure Jack may have been one of your mentors. Were there any others?

Cox: Yeah, they really were. Pretty interesting, because a lot of the responsibility I had was direct interface to customers and support the salesmen. All the salesmen at TI were generalists. They sold whatever, you know, GI, GE, whoever they called on, what they needed. But when they really got down to specific devices, functionality, they'd bring in marketing people from the divisions to close major agreements with major customers. And so I had a healthy--

Katz: Who taught you how to do that?

Cox: Ed Gelbach.

Katz: Ah-ha. <laughs>

Cox: At the time that I was working at TI, Ed was the OEM sales manager for TI, and that was before he joined Intel in 1971, '72.

Katz: Right.

Cox: And he left TI, I think it was actually '71, maybe '72. But he was a real mentor. Jack was too. Jack was a very, very smart guy, as you know.

Katz: Yeah.

Cox: But, and Ed was a very different type of guy. But I'd say at TI those were the two.

Katz: Mm-hm. Well, it's interesting now that you-- you ended up all three in the same place.

Cox: <laughs> Yeah.

Katz: For a while, anyway.

Cox: Well, that's how I ended up over there. You know, that story go right into it but, you know, I replaced a guy at Intel who went on to bigger things was Mike Markkula.

Katz: Yeah.

Cox: Mike left Intel after Jack came in and Mike was the overall marketing manager of Intel. This is 1974, seven-- and we weren't divisionalized, as you'll recall. And Mike reported direct to Ed Gelbach and had all internal marketing while Ed had marketing inside and all the sales outside. And Mike, when he, I don't think he was bitter about it and I got to know him pretty well, but when Jack came in to replace Ed, Mike kind of saw the handwriting on the wall well, I didn't replace Ed, I didn't move up.

Katz: Yeah.

Cox: I'm still doing the same job. I'm sure it had nothing to do with Jack, 'cause he didn't last long enough to decide whether Jack was a-- he liked working with him or not. But when he left I still remember I got a phone call and Jack said to me said, "Well, now I got a place for you, 'cause Mike Markkula just quit".

Katz: Were you eager to get out of TI at the time?

Cox: No. No, not at the time at all. But I didn't see the next big opportunity at TI when I had gotten to be the division marketing manager in Houston. You know, it wasn't clear, at the rate that TI was growing, to me the most logical next step for me was to become a division general product manager, general manager. But that would've been a pretty big step and the company wasn't growing that fast on an individual-- it was growing fast, but individual product lines and individual technologies. And it was pretty clear by late '74, that the next big thing was going to be solid-state memory and microprocessors. Even then you could see the microprocessors, although Intel was solid-state memory at that point.

Katz: Mm-hm.

Cox: And it was just too big an opportunity to fail. And, but I looked at another thing. I think at that time, if you were going to stay in the semiconductor just to stay in Texas, you were going to work for Texas Instruments. That's maybe changed a little bit today 'cause, you know, Motorola came in there and went into Austin.

Katz: AMD was there for a while.

Cox: Every-- AMD. But yeah, that was long at, that was the late '70s--

Katz: Yeah.

Cox: -- when those guys started migrating into Texas with other than sales people. So to me it was a pure opportunity. I thought I knew Jack well. I thought I knew Ed Gelbach. I thought that there'd be huge opportunity 'cause they were growing so fast that they need senior positions rapidly.

Katz: Of all the stuff you learned and did at TI, which of those things served you very well at Intel?

Cox: I think the aspect of product margin, product cost, return on investment. Because ultimately as I had hoped within three years of joining Intel, I took over the RAM division as the general manager of static and dynamic RAM and moved to Oregon. And I think that the experience I had, you know, when you're in marketing you got to understand just about every aspect of it, what it cost to develop, what's feasible to develop from a process and product standpoint, what the customer wants, what'll sell, what the customer needs.

Katz: You guys were pretty big at the forward pricing too.

Cox: Yeah. Yeah. That was a very, very good background to put you in a position to potentially, you had to understand the engineering aspects, I mean the multidiscipline in engineering, both process and product. You had to understand the sales aspect of it. You had to understand cost to some level. And it became clear to me quite rapidly at TI that that would be the normal course for me to take for growth and success in the semiconductor industry, not going over and learning to manage a new single disciplined product like engineering?

Katz: Mm-hm.

Cox: Clearly the next step would be toward general management. Could have been maybe going into worldwide sales aspect, which I did a little while for Intel when I went to Europe, but that also had a general management responsibility, and P&L responsibility. So and that was very attractive for me. I figured it be faster opportunity at Intel because it was such a new company and was being so successful.

Katz: And attracting some good people.

Cox: <laughs>

Katz: Good people is really what I thought made Intel the king of the hill at that time.

Cox: Oh, without question. Absolutely.

Katz: All right, so you got to Intel when?

Cox: '75.

Katz: '75.

Cox: Very early '75.

Katz: And your first job there was to replace Mike Markkula.

Cox: Mike Markkula. Yeah.

Katz: As basically Intel was still a memory company then. They had just kind of fiddled a little with micro processing.

Cox: Yeah. They were just getting started.

Katz: There was no business there.

Cox: No. It was a memory-- it was memory marketing.

Katz: And what were the first products you were trying to hawk?

Cox: Well, you know, that came right at the time when I-- the big product for memory at Intel was 1103. The one--

Katz: Mm-hm.

Cox: -- the, you know, the 1024 [bit].

Katz: Yeah.

Cox: And when I got to Intel it was just, if you will, the next standard at 4K and it was a pretty good marketing battle because, you know, Mostek came out with a 4K processor with Multiplex--

Katz: And so all those TI guys that didn't want to move to Houston, right?

Cox: Same-- yeah, that's true, the whole team. But they came up with a concept that was brand-new at that time, Multiplexed I/O. So they were able to get a 4K RAM in a 16-pin package.

Katz: Mm-hm.

Cox: TI didn't quite take it quite as far and they came up with an 18 pin package and they were trying to push to make their move into memory because everybody recognized solid-state memory was coming. And remember the original Intel was … you had 20.

Katz: Oh, it was a 20, yeah.

Cox: Yeah. And there was no standard.

Katz: Mm-hm.

Cox: And interestingly enough with all the successes Intel had, even after I got there, in memory … before they decided to concentrate totally for a number of reasons on microprocessors. They lost the battle for 4K standardization. Mostek clearly won--

Katz: Yeah.

Cox: -- with what was a much more efficient packaging technique in a 16 pin package. And I was one of the original team that came up with the 2104, our 16 pin. It was quite clear and I think it was quite clear to a lot of the sales and marketing people, including me, that when Mostek came out with a part and it worked, so Intel couldn't rely on the fact that well, we had the 1103. Those guys aren't going to get you a 4K RAM. Their product was a very good RAM. They had the whole package. And I was part of the team that said, "Look, we got to develop".

Katz: You had to learn that from the customers, I presume. You saw that--

Cox: Yeah. You trying to sell your product and no one's-- no one's eating the dog food. <laughs>

Katz: It's called the tied.

Cox: Yeah. That's right. It was pretty clear that Mostke had won that battle.

Katz: Yeah.

Cox: And with the multiples of four and staying by four or by one--

Katz: What was the process of convincing the company to switch? You must've been--

Cox: It wasn't as difficult--

Katz: You must've been right at the point of that because you were out there with the customers and the sales force.

Cox: Oh yeah. Absolutely. There was two of us who were right at the point of it, Dave House.

Katz: Yeah.

Cox: 'Cause Dave House had applications. We were--

Katz: Yeah.

Cox: -- total contemporaries at that point in memory. And so House and I were right at the point, but we had a very interesting ally there. You know, this whole growth had come about because Ed Gelbach, who would really be the first VP in sales and marketing at Intel, there was a guy before him, but he didn't last very long and Ed was the first one that grew and grew the company. Ed had been moved up to be the general manager-- vice president and general manager of the components group.

Katz: Yeah.

Cox: And all engineering, all operations, all the wafer fabs. And Jack Carsten came in and replaced him in sales and marketing. So when we were advocating-- when I say we, Dave House and I were advocating, "Hey, you aren't going to win with this 20 pin package. The longer you fight it and not offer an alternative to Mostek, the more you're going to lose your position in"--

Katz: So you had to convince Gelbach. Now that he runs the division--

Cox: Well, Once you convinced him you'd done a lot. But you ultimately you had to convince Andy Grove, come on. But, you know, Ed came from a marketing background and he was the West Coast manager of TI in the early days when I first joined TI. So he understood the sales aspect. And there were a lot of people in the early days of Intel that used to talk about, "Well, we don't understand what we need

marketing and sales for. We'll just built a better mousetrap and the world will beat a path to our door", and you saw some of that. And that was true with the original solid-state memories, 'cause there wasn't an alternative. But by the time you got to 1974 and 1975 and there was clear competition on the horizon, at least in memory, you know, then people said, "Well", they responded to that type of thing and, of course, we had a real champion in Ed Gelbach who understood that.

Katz: Were you concentrating mostly on the RAMs or was the EPROM starting to have an effect by then?

Cox: No, you know, that was one of the exciting things about it. Because we weren't divisionalized, you know, the UV EPROM was already out, the EEPROM was coming. And the bigger thing, you know, you recall that even and when you talk about random access memory, People don't give Intel credit for actually developing the static RAM family as much as Dynamic.

Katz: Oh, it's what kept them alive while they were working on the Dynamic. Yeah.

Cox: That's right. And, you know, the person that really showed that there was a future in bipolar was the Fairchild guys with the 93415, the 1K. You know, I laugh and I tell people the first memory that I sold at TI was a 16-bit, 16-bit, not-- no, it was a 16.

Katz: Not even a 64 bit.

Cox: 7489, the original scratchpad memory is 16 bits. You remember that one.

Katz: I used those or I shopped for those--

Cox: Yeah.

Katz: -- when I was making mainframe computers in the '60s.

Cox: Scratchpads and they were-- they were the original cache.

Katz: Yeah.

Cox: It was 16-bit and then, you know, along came, what really built the MOS, and I have to give some credit to others to for this too, static RAM was by this time MOS in general, and CMOS in particular, was beginning to show a performance, and a number of the engineering applications people at Intel

demonstrated that they could build a 1K static RAM with the same pin out as Fairchild's 93415 bipolar 1K and have the same type of performance at much less power and much lower cost process. And that got started the whole static RAM evolution -- the by fours, by 16, and that was a big-- that and both EPROMS and UV PROMS, there was an awful lot of activity in that time, the mid-70s. The RAMs were already kind of on their treadmill. You know, it's "by four" [4x]. As soon as you can get the process smaller, you could multiply the bits by four--

Katz: Yeah.

Cox: -- and you could sell the chip for lower price per bit, not lower cost per chip--

Katz: Yeah.

Cox: -- you'd convert. But it was pretty straightforward.

Katz: There was a time at Intel when the chips, especially in the EPROM side, but also I think in the RAMs too, that Intel would have the next-generation part ready and, but they'd still be the only one in the market with the first generation, until some competitor showed up, then they'd spring the next generation on them. Was that part of your doing? <laughs>

Cox: Well, yeah, I think it was. I think I certainly was involved with that. But I think that as we got more and more competition and with Intel's stated and acknowledged margin goals, Intel didn't particularly -- when there was no one else around -- rush to get the next generation. Because you would have a dip in margin.

Katz: Mm-hm.

Cox: And as long as they could control that conversion they would wait 'till it was really financially better from a margin standpoint, not just a cost, but a margin standpoint on what they could give the chip to introduce it. As people came along with Mostek with the 4K Dynamic, some of the Japanese suppliers like Hitachi, NEC with the statics, Intel could no longer control the timing--

Katz: Yeah.

Cox: -- as perfectly, and it made us much more competitive. We learned a lot.

Katz: Indeed. Well, there were times when the industry always went through these ups and downs of supply and demand. And when product was tight there were people, you know, coming over from Japan with empty suitcases and going back with RAMs. And then--

Cox: <laughs> And it wasn't tight.

Katz: Yeah. Yeah.

Cox: They'd come over with a bag full of money and say, "Give me a lower price".

Katz: Yeah. Yeah.

<laughter>

Katz: Well, okay, so your work at Intel, when you first got there, was taking that new company's new technology to the world, was it a big staff or did you have to do it all yourself or what?

Cox: No, I had a pretty good-- I had a pretty good size staff. I would say that, you know, that in the mid-70s in memory marketing it was again, it about the same size of what TI had in TTL. We had about 25 folks and that didn't count the applications, because I didn't handle those. But we had about 25 people that were concentrating specifically on memory product from a marketing standpoint, and so it's a pretty good size group of people. And then, you know, by the late '70s, that's when product, microprocessors had taken off fast enough. We had a large memory business. The memory business, RAM business was over $100 million a year worldwide in the late '70s.

Katz: Mm-hm.

Cox: And so, the company began the divisionalization process. As you'll recall, again, we took RAMs up to Aloha in Oregon, and I went with the RAM division as the general manager of operations. The non-volatile memory stayed in California under George Schneer.

Katz: And then House moved over and started doing Micro.

Cox: Microprocessor.

Katz: Yeah.

Cox: And building a real true marketing group on microprocessor alone and that's the same time that, you know, Bill Davidow went over there and they turned that into ultimately what became the processor group.

Katz: Yeah. All right, well, you moved up to Oregon. That was a big startup activity for Intel. You had to get a Fab running as well as a marketing and engineering group.

Cox: Yeah, the Fab was, you know, when the Fabs were not you-- but that's true and we certainly were involved in it but, you know, at that point Intel's divisions, Fab was part of central manufacturing and had a different organization reporting up to Gelbach, along with process engineering. The divisions, the P&L divisions were really a marketing group, a product development group, and that's--

Katz: Were you able to bring most of your existing staff up there or did you have to recruit from scratch out there?

Cox: Yes. No. We moved-- we had no major openings when we went up there. We split the memory group up and we had plenty of people who wanted to go to Oregon. It's kind of interesting but, you know, they even recognized then what the cost of living was down here I think.

Katz: Yeah.

Cox: And we were able to split the memory group up pretty good and really have a total concentration of people to go both directions. And we even moved some marketing people down -- we moved the microcontrollers down to--

Katz: To Phoenix.

Cox: -- down to Phoenix.

Katz: That was a little bit later.

Cox: Yeah. It was a little group.

Katz: Yeah.

Cox: But yeah, we had enough to really fill the original organization out.

Katz: Okay, so in Oregon what major problems did you have, if any and how did you work on them?

Cox: Well, I think that there's a lot of self-inflicted. Intel, even in the later years when I was still there, it was very, very centrally managed. While Andy Grove was a demonstrated outstanding manager, he was very much a, I would call him a micromanager. But he controlled all aspects of the business. And even when you talk about in '78, when Intel, when it was $500 million, probably, something like that. I know it was $100 million in '75. First year it was $100 million when I went there, the revenue of Intel. And I know in '83, when I left, it was a billion. There's a funny story about that because I-- the same thing happened to me at TI. When I joined TI at '69, that was the first year they did $100 million. You can go back and look at the records, it's a public company. And I left in '84, that was the first year they did $1 billion.

So, but even at-- in the '78 time, '79 timeframe when we moved to Oregon, we didn't have the infrastructure for delegation. We didn't have a lot of the resources. And that hurt us in a lot of ways in developing the business and it slowed us down. And I think you'll recall that I didn't end up staying in Oregon very long because it actually it was Andy Grove and Ed Gelbach came along and said, "Why don't you-- why don't we send you to Europe to become the president of Intel, Europe".

Katz: When did you go to Europe?

Cox: '79.

Katz: '79.

Cox: Says only a couple of years.

Katz: So you missed the volcano, huh?

Cox: Well, you know, I hit in the volcano. My-- I was still in transition.

Katz: Uh-huh.

Cox: But, you know, the real reason that that decision was made, and it was an Andy Grove and executive staff decision, was that Intel was significantly under pressure from competition because we didn't have a P&L organization, customer support in Europe. We didn't have the concept anywhere in the world of a geographic P&L. We had a bunch of salesmen. They took orders in dollars, FOB California. They sent orders by whatever mechanism we had back to the U.S. The sales orders were acknowledged, sent back.

If a customer had a problem with a product, all the salesmen could do was call the division in the U.S. and say, "You know, can you help me"? We had no inventories. We didn't ship anything out of Europe. What inventories we had were in our independent distributors. And as we got into early '80, and things were really competitive now. A lot of real established companies, whether they be American TI, Motorola, Japanese, like Hitachi or NEC -- they could provide full service to the customer.

And that was really the reason I was sent there. The concept was well, he knows all those people. He came into Intel working with all those salespeople over there. He understands the general management approach and P&L approach of TI. He'd been in the division here. So he can go over there and install it over there as a geographic P&L. And it was a wise decision, because I did know all those people and I felt very comfortable doing that. And we'd gone through some of that in Europe, even in Oregon, although geographically it wasn't, you know, that different.

Katz: So I'm going to back up just a second here and reflect that of the career move you have just mentioned getting what, TI was your own decision to go to it. But after that you were kind of pulled in every place that you moved to. You were pulled from TI to Intel, from Intel, Santa Clara, to Oregon, and from Oregon to Europe.

Cox: And, you know, I think I knew where I wanted my career to go, but I was fortunate enough to first of all have some mentors, if you will, that taught me very well. And I also was fortunate enough to have people, and maybe it's part of-- this was the aspect of going to an Intel small enough that even in '78 or '79, if you were having some level of success, and perceived to have some level of success, everybody in the company will recognize it. Andy Grove could recognize it. I mean you remember he used to have these shoot-offs between the marketing groups, and he'd ask the salesmen when they'd come in, "Who's the best marketing group"?

Katz: Yeah.

Cox: He'd score everything. And I was very fortunate that I think every time after we decentralized until I left the marketing group my marketing group won every award by the sales of the best marketing group in the company. And so I was, I won't claim that I was good or bad, but I was perceived to be the right person for the next step.

Katz: Not to start an argument, but I think your memory products at the time were probably the easiest things for the sales force to deal with.

Cox: Oh, absolutely.

Katz: So they naturally would…

Cox: No, no, there were a lot of reasons why it all fit together, no fault of mine. <laughs> Absolutely.

Katz: Okay, so you got to Europe and you started-- you had to grow that operation essentially from the ground up. How did you find people?

Cox: Well, you know, I went into a relatively extensive negotiation with both Gelbach and Grove about taking that position.

Katz: Mm-hm.

Cox: And I said, "Look, it's very clear. Andy always gave you, here's your goal, here's what I want you to do and you never didn't understand what was expected of you". And I said, "Look, I'm going to need help. I understand the process, but I'm not a financial educated CFO or controller". So I said, "I want to take a senior financial guy with me and I want to-- and I want you to let me do that. I want you let me pick him. I'll take the responsibility to get him to come", but I said, "I want to pick, and I want to have a choice of anybody in finance". Because this was the first time they were going to try to put one of these in -- of course, other than Larry Gutknecht. And Grove told me, "All right, you can have anybody". And I said, "All right, I want-- and I want somebody from customer service", because we had no computers and we had to put in a computer system where we started entering or doing forecasting, forecasting the Fab. We put in a whole computer system and I said, "I want to choose a customer service person". And I said, "You're worried about legal aspects so I want to choose an ex-pat from the legal group to go with me. And if you'll let me do that", I said, "I'll take the job". And Grove said, "Go do it". And I got, you'll know these names, I got Bob Reid.

Katz: Mm-hm.

Cox: And Reid stayed with me for two years and then when Gutknecht, they took them away from me. I wasn't back yet, but he became the CFO and Bob was a very, very qualified individual.

Katz: Right.

Cox: And he put the whole system-- the financial system, in Europe. They gave me oh, the guy the got his li-- he was a RAM engineer who went and got his license to practice law from Santa Clara.

Katz: Oh, Tom--

Cox: Tom, yes.

Katz: He's the legal guy there now.

Cox: Well--

Katz: Or was for a long time.

Cox: Well, when Tom left Europe--

Katz: Yeah.

Cox: -- he replaced [Roger] Borovoy.

Katz: Yeah.

Cox: He became legal counsel.

Katz: Yeah. Yeah.

Cox: And the third one, I picked one of the top order entry warehousing people, a young lady by the name of Sally and I'm embarrassed to say her name and--

Katz: Feder?

Cox: Feder. Yes.

Katz: Yeah.

Cox: And she came with me. And that's the end of the story, you know, and--

Katz: All right, so you had the seeds there.

Cox: Yeah. And they knew--

Katz: You still had to staff it all up and figure out what to do in the various countries.

Cox: Sure. But, you know, there was an awful lot of all the major international semiconductor companies had presence in Europe, whether you're a Motorola or a TI, and they understood the business. They understood the customers. I mean, you know, the customers were Philips, the customers were, you know, Siemens, everybody understood them, ICL So we could hire those kinds of people.

We just had the seeds who understood how Intel did it. And even at that time, you know, Andy correctly so, was very high on culture. This is the way we do it at Intel. I was able to take those three who were literally the key, but also about five really senior management people. And I think there's a-- this is a funny story. I won't take credit for it, but we pulled off I think something pretty dramatic in about two years. And about oh, two years after I'd been moved and had been in Europe, they made the same kind of a move in Japan for Asia and they sent Gene Flath.

Katz: Mm-hm.

Cox: You recall that?

Katz: Yeah.

Cox: Komo stayed in sales-- you stay in sales. I think Andy looked and it he said, "This is the only way you could Intel. They've got to understand the process, the procedure. You've got to give 'em the people". And, you know, he took Derby over there for a while and Gene did the same thing and I don't know, I can credit that maybe I helped build the model for Intel. I think I was certainly a part of it and how do you do it.

Katz: Mm-hm. But ultimately, it changed to try to run all the things local. But first you had to Intelize all those geographies.

Cox: Sure. Sure. You weren't going to change the way Intel did it, and with the culture, you shouldn't.

Katz: Yeah. Yeah.

Cox: And with some of the strong management in the U.S., it started with Grove, you wouldn't have anyway. <laughs> But that's how we did it. And, you know, I went through a little bit of it in Oregon

because it was geographically not the same thing. But still you all of a sudden you couldn't walk down-- we were all in Bowers, that one building. I need help. I'll just go right over here and talk to whoever I need to to talk to. Suddenly we found ourselves in Aloha, Oregon and no one even knew where that was, the suburb of Beaverton.

Katz: Even worse nine time zones away.

Cox: Yeah. Well, you know, you probably remember this story. When people talked about the first remote sites in Intel outside of California, and they ended up in Chandler, Arizona and Portland, Oregon, people asked, "Well, why there"? And Intel was so centralized in its management and maybe that was right because they were focused and they got ahead of everybody else. One of the key criteria was same time zone.

Katz: Yeah.

Cox: I know that to be a fact. We're not going to move somebody to New York, we're not going to move somebody to even Mid-America. There are two-hour time difference and it's going to increase the problem of transferring the management talent and management rules. And that was one of the criteria that was ended up why Chandler and Portland.

Katz: Yeah. But ultimately, the market wasn't only there, and you got to be where the market is too.

Cox: Sure. Sure. And then you had-- and, you know, at some point you'd grow, you'd have more people capable. You will have transferred the job. But so there was some of that aspect when we all went to Oregon.

Katz: Mm-hm.

Cox: Yeah.

Katz: All right, well, in Europe when I showed up there it was after it was in '83 or so and you were just getting ready to leave.

Cox: Yeah. That was just before I left.

Katz: Yeah. Yeah.

Cox: I was getting ready to go. Yeah.

Katz: And it was, you helped recruit me over there.

Cox: Yeah.

Katz: I mean House pushed me and you pulled me in and I ended up going.

Cox: Yeah.

Katz: Anyway, by that time the organization had been fairly well-established and it was running fairly smoothly. What made you decide to leave?

Cox: You know, that's an interesting story. I think once again it was opportunity. I thought I'd had a pretty good career at Intel, starting out really at end of '74 and now we're talking about the end of '83. And, you know, I had about 600 people. I had-- I was a general manager with pretty significant P&L responsibility. But I saw the opportunity slowing down for me at Intel.

And you'll recall that in the '83 timeframe was probably the biggest reorganization up until that time that Intel had ever gone through. And, you know, Ed Gelbach stepped down, central sales and marketing came out from under the Components Group and went to go with Davidow. They formed three big product groups, 'cause the systems group had grown now. They brought in what's his name from Univac I'm embarrassed again, I can't say his name, but.

Katz: Oh, but it starts with a B.

Cox: You know what I mean. Yeah. But it didn't matter.

Katz: Yeah.

Cox: And House went over and took over the microprocessor group. And, you know, it was always a temporary job and I felt that ex-pat should be temporary in Europe. You go to Europe for the-- put the capability in, but then you want to train locals to develop the same capability and you come home then. And not only is that important financially, I think it's the only way to grow the organization. And so there was no question I was coming home--

Katz: But you didn't go home to Intel.

Cox: Huh?

Katz: You didn't go home to Intel.

Cox: No. Well, you know, I found out about the big reorganization that was coming in 1983 before it was ever announced because it came out of the slurp. And Bill Davidow came to Europe and said, "I'm taking over sales and marketing and we're reorganizing the whole company". And I said, "Well, okay and that's good, change and growth". But I had perceived myself mainly as a general manager, even though I had a big sales geographic responsibility area. And the only job that Intel could really offer was to take over international sales for Davidow, an officer in the company and do some of the things you did in Europe for Asia. Because Asia hadn't gone through that yet, which they did later, and South America, just general worldwide situation. And I wasn't particularly interested in that position for a couple of reasons. I didn't really want to be on the road my whole life and I felt well, if I come back to Santa Clara and my responsibility is international, you're going to be two thirds of the time in international, just period, that's your job. And I didn't particularly want to do that, number one, because I had gotten married, that was part of it. Number two, I didn't want to go back into sales. I viewed my future and where I wanted to take my future was more responsibility in the general management area.

I won't say that well, I'm going to be the next CEO or whatever. And so again, the opportunity for me slowing down, there are a lot of good people at Intel. I didn't think they were putting somebody in and say, "Well, I'm better than him". But I just didn't see any opportunity and they had kind of had this slotted for me. They had to. And I said, "Well, I don't really want to do that, and I think we ought to look at something else. And it's time for me to go." And the other thing that was true that you'll recall, this was early '80s, probably the most explosive time in technology startup and venture funded business we've ever had.

Katz: Yeah. Yeah. That's true.

Cox: Came out of the '70s. Everybody was, you can think of numerous Intel people--

Katz: Yeah. Yeah.

Cox: That I knew and outside of Intel and I was kind of intrigued by starting something from a blank piece of paper. And although I'd done some things developing a capability in Oregon, developing a capability in Europe, I had not started from a blank piece of paper to build this company and I was very interested in doing that. And so that's what I did. And the very first company I founded was Ateq when I came back.

Katz: So how do you go about that process? I mean you had big company experience and the VCs look at you and say, "What do you know about being an entrepreneur"? How do you end up bootstrapping a new company??

Cox: A couple of things. First of all, although I would consider myself the-- it was not my and this is what they look for mainly, I think first in an entrepreneur if you're a venture guy is the technical background. Does he know this business?

Katz: Mm-hm.

Cox: And two very senior, and you know them, process people associated with Intel and one was from the University of California, Berkeley, Bill Oldham, who was long-term consultant to Andy Grove and Gordon Moore for RAM processing, wafer Fab processing. And now I can't say-- and the other guy was in Aloha in the Fab developing RAM processes. And they came up with this idea for capital equipment, it's a capital equipment Company. And the idea ultimately was to build a fab-compatible direct write piece of equipment using not E-beam, but optical technology. And a couple of the best experts in the world were the brains behind the deal. They wanted a businessman to have a partner and they found me. And I wrote--

Katz: So serendipitous timing.

Cox: Yeah. And yes, yes. And I wrote the entire business plan from-- I sat down and interviewed Bill Oldham and I'll say the guy's name and I can't do it. I knew Bill when I was running the RAM group, of course. And also this individual who was in the Fab, of course, 'cause I was running, we had to interface very closely with the Fab process people if we were to develop the circuits. And so I sat down and talked with him and it made a lot of sense. It made a lot of sense here. But, remember this was a time other factors were happening. People thought that standard optical photo processing was going to run out of gas at about a micron, just we couldn't get that small. So x-ray or some other method or enhanced optical, direct writing was going to be required to get the submicron lines. So the world wanted to hear this. And the E-beam direct write, had already shown that it was very difficult 'cause it was not compatible with an optical Fab for all the other layers and very expensive. So we were able to sell and raise money quite rapidly from a consortium of top venture capitalists at the time.

Katz: Who were your major investors?

Cox: Well, we started out at the time, the three investors that were the seed round guys were Sequoia.

Katz: They know what they're doing.

Cox: Yeah. And that was the days of Don Valentine and Pierre Lamond and Pierre was on the board, Bill Hambrecht, Hambrecht and Quist, and a group from and Harry Marshall from I'll say the name in a minute, they have since gone out of the business, but a big, big, big money investor. And we ended up ultimately with, we had a who who's who of we had Oak, we had, you know, all the venture capitalists in the business in the--

Katz: So how big was the board with that many investors? They all wanted to have a position, right?

Cox: We had those three tops the seed guys, the other guys had visitation rights, but they never got board rights. And, you know, then we ultimately, we were successful in building a very good reticle writer and we had got a lot of money from SEMATECH. SEMATECH believed, and that didn't hurt that I knew Bob Noyce wel,l who was the first CEO of SEMATECH. And we were able to convince, I don't know, everybody believed that mask making and writing, you know, again, if we worried about these minimum geometries was going to be a critical building block, an enabling technology for the future of semiconductors. We ended up, in addition to semiconductors investment money, we got millions of dollars in NRE from SEMATECH to make sure we developed a capable product. And then finally--

Katz: Did you have to give them technology or anything?

Cox: No. But, you know, SEMATECH was never did. They helped develop the applied material, but they never took control of it from a standpoint of ownership, royalty rights to technology. And, and then finally, kind of the straw that really changed and made Ateq was in you'll recall too, in 1988, PerkinElmer was the largest company in the world in capital equipment with big, full field aligners and also E-beam mask equipment. And PerkinElmer decided to get out of the [E-beam] business. And the only E-beam competition was Japan, and the Japan paranoia was running wild. And we were getting-- having a problem and we at this point it was 1988 and we weren't even breaking even and so the investors had been putting money into Ateq, shipping a lot of machines for five years and we were struggling.

And part of the reason the two of us were struggling is we were competing with each other, price and every other way. And this is a long story, but when PerkinElmer tried to sell off their business as a single business, nobody wanted it. And you'll recall that Silicon Valley Group bought their scanning business, their optical printers, but nobody wanted their E-beam and they were in negotiation to sell it to Japan and, which was a crippling thought to SEMATECH in the semiconductor industry. And the only reason they didn't move more quickly is IBM had given some of their E-beam technology to PerkinElmer to help reinforce them and IBM had certain rights what happened to that technology if it was sold. Well, don't need to go any further, that's a known fact.

And actually, I was closely involved with SEMATECH and Bob Noyce at putting the two companies together. And Bob Noyce engineered that deal. Etec and Ateq merged and at the time became the

strongest reticle writing firm in the world, dominated the original submicron products, 'cause we went 5X reticles, so even with a micron you were drawing 5X lines and we owned the reticle writing business when they put the two things together. And it was a very, very complex deal in a way. Bob Noyce personally went out and put five companies together. He got, he got IBM to put their technology into the deal and they got 15 percent of the company for it. <laughs> He got PerkinElmer carry back 15 percent of the company, not sell it all, stay in. He got DuPont, who was the big person in reticle writing at that point, they had independent _____ to buy 15 percent of it. He gave 20-- he gave 15 percent of it to Ateq and there was-- they're two other companies in the deal that we formed Etec Systems, independent company, which went public ultimately and was quite successful financially and every other way. And ultimately, was purchased by Applied Material, still reports to Applied Materials. Not near as dominant a force as it used to be. But that was my first experience of building my own company.

Katz: So, how long did it take between spark in your eye and getting it--

Cox: '84 to '92.

Katz: '84 to '92. So, you were there eight years.

Cox: Because when the companies were merged, I left. I didn't really want to run a capital equipment company. Etec was the larger anyway. We wanted to put the president in from there. I was the CEO of Ateq. I wanted to go back to the semiconductor business. So, everybody was happy. And my COO took over the whole optical part of the business. And it worked out well for everybody.

Katz: So, that was when Weitek was starting up then or had been alive?

Cox: Well, no Weitek you know was a twenty-four-year-old company. Weitek was changing businesses. They were going from an Intel add-on coprocessor, because Intel put the floating point on chip.

Katz: Yeah.

Cox: And they were out of business. They tried to move into what we called the GUI, the graphics business. At the time we called in Windows accelerators.

Katz: Yeah.

Cox: And they were trying to change into a whole new business. And by the way, now along comes some of our old mentors. Jack Carsten was on the board.

Katz: At Weitek?

Cox: At Weitek. And Carsten recruited me into Weitek.

Katz: A-ha.

Cox: That's right. And before Carsten had taken that job, Dave House was on the board at Weitek.

Katz: I knew that. I didn't know about--

Cox: Well, Dave House actually stepped off the board when he took over the microprocessor group because both sides looked at it as a conflict.

Katz: Yeah, yeah.

Cox: And they helped each other. They were very symbiotic in the early days. And Carsten was already out of Intel and was doing his venture stuff. He stepped on the board. He took House's seat. And then years later, already a number of Intel people had gone over there, and were already working there, including Bob Derby, marketing manager. Carsten was the chairman of the board. One of the--

Katz: I think-- was Danny Cho an engineer there?

Cox: Yeah, and one of the guys-- the guy that used to run Livermore Fab when you and I first joined, he has his bro-- his uncle-- his cousin also.

Katz: Yeah, Howard and--

Cox: Gopen.

Katz: Gopen, yeah.

Cox: He was the operations manager.

Katz: Howard worked for me. It was-- no Charles worked for me. Howard was your guy.

Cox: Okay. But anyway, Gopen was there. And I hired Ben Warren in for process engineering.

Katz: It was an old home-week for you.

Cox: We came right back as a home-week. And there were a number of reasons why Carsten came after me because his view of this was very much a competitive commodity business. And the graphics business was going to turn into that. And he said you learned that all in the RAM business. And you were the-- at least while I was there, and there was other factors working for me. I was still quite-- Intel was still quite successful in even dynamic RAM. Of course we still had a huge leadership position. Once it came down to pure commodity and price--

Katz: By that time, Intel was out of it. They couldn't--

Cox: Yeah, and I was out of it. See because they went out of the business 64k, and I'd been in Europe for three years. But when I was running the RAM division, it was a very, very, very successful contributor to Intel. So, Carsten said, "Why don't you come over and do this." And I didn't have anything else to do because the Ateq thing-- again, there's a number of these timing things in my career that were-- certainly, I had nothing to do with them. They were just right.

Katz: Always helps to be in the right place.

Cox: Yeah, yeah.

Katz: All right. Well, how long were you at Weitek?

Cox: I'm going to count backwards. I went there in '92, and I left just at Christmas in '95. So, it's almost three-- two and a half, three years almost.

Katz: During that time, were you bringing the company up? Or was it-- was it still struggling the whole time?

Cox: No. No. Two things, we totally turned over the product line that we were no longer making any kind of coprocessors, period. We were out of the processor business. And we were one of the early dominant forces in--

Katz: Graphics.

Cox: Graphics chips, and were very successful as long-- and what we missed. I'll tell you a point we missed. When they were add-in cards, you know in the early PCs--

Katz: You had to have a whole card.

Cox: People really wanted those graphic cards. They were the gamers. And they were the artists. And they were the developers. Your standard PC on your desk at home didn't need a graphics card, or graphics capability, and that kind of performance. And as the graphics chips got less and less expensive, and higher and higher performance, and we got into the area where Gordy Campbell showed everybody through Chips and Technologies, you could put it into a couple of chips. And the graphics went into the--

Katz: On the main motherboard.

Cox: They went on the motherboard. Weitek had lost the formula partly because of process, partly other reasons. And we were riding the add-in card business. And we were dominant in the card business. We had all the big card suppliers. And rather than use numbers, I can tell you that in that two and a half years when I joined a company to when I left, the stock appreciated by seven times. But we were in trouble, and we knew it internally more than the market did. And ultimately, the company was sold to Rockwell who made it a business. They were doing that edutainment products for a while. And they wanted our technology in the graphics area. And that ultimately came-- again, spun out of Rockwell and became Conexant. But I left. I left before this whole--

Katz: Nvidia hadn't taken over the market yet.

Cox: No, and we were losing the market-- what happened was first S3 came along. There are a number of us competing in there. S3 came along and took a dominant position. Then 3DFx, another Gordy [Campbell] company, came along. And then Nvidia was the ultimate winner there. And they did some clear things that were very innovative.

Katz: Yeah, my observation at the time with all that machinations in the graphics chip industry was that each group would come up with its great idea, which would kill the previous group. But they never had a good follow on. So, somebody came along and killed them.

Cox: No, and every six months, you needed a new chip.

Katz: Somebody came and killed them.

Cox: Yeah. Yeah it was--

Katz: And the design cycles on the PCs were short enough that they were shorter on the PC's system side than they were on the chip side.

Cox: And by the way, from a semiconductor standpoint, the first industry that really took advantage of the ASIC design methodology was that graphics business. That's how they churned them out so fast. And Weitek never knew that. We were design--

Katz: Custom chips.

Cox: We were designing transistor up because we were used to building coprocessors. And we never developed an effective design methodology that could allow us to do a couple of turns with a small number of engineers a year. And our first graphics chips won out because they were so fast. They were so powerful because they were used to designing coprocessors. And the companies that won, it was first-- literally, all three of the companies that won in order ultimately, and ultimately the winner was Nvidia. They mastered the ASIC design methodology. I believe that was the biggest differentiator. I sat there and watched it happen. But I think it was the biggest differentiator. And the Weitek thing, it gets old. The technology went, the guys went--

Katz: Were you part of the sales team to get it bought by Rockwell?

Cox: No, no, no, no, I had left the company. I'd gotten into a win/lose deal with the board about selling the company. And at the time, the company didn't want to be sold. The board felt it was better off independent. Let's just leave it that way. And that happens, that happens. It was all very, I don't know, professional, if you will. So, yeah-- no, I was gone before they sold the company.

Katz: So, they took your advice in the long run anyway.

Cox: Well, they had no choice.

Katz: They had to.

Cox: Yeah.

Katz: From there, I lost track of you much after that, after Weitek.

Cox: Well, you know--

Katz: You ended up as a consultant for a while. And then you became--

Cox: I moved over to the dark side with venture capital. I think I had finally decided my biggest contribution to the industry, I don't care whether you're talking about RAMs, was helping startup technology companies, young engineering groups that started companies, successfully scale and commercialize their product.

Katz: And operate the company.

Cox: And it came from my marketing background. It came from my engineering-- because the companies I went to, I thought I understood the product very well. I understood the application. And from the marketing and sales background, I understood how to position it for rapid growth in the customer base. And a couple of companies, a couple of venture capitalists who had gotten to know me quite well from Weitek and from Ateq, and specifically it was the guy that started me down this path was a guy at the Lightspeed Venture Capital, old Weiss, Peck, and Greer.

Katz: Oh, yeah.

Cox: And he'd put a small investment, five million dollars, into a MIPS-based startup company. It was developing MIPS circuits, QED. And it was twenty-five engineers, no marketing, no sales, no nothing. And they had started out as an independent design group designing chips for MIPS. And they were paid in NRE. And MIPS actually paid them a small royalty. And they were an independent design house. And when MIPS got taken over by-- long story, got taken over by SGI, and SGI started moving their design teams into big chips for big servers, there was nobody left to support the MIPS architecture in the desktop, and the MIPS processor. And they were very willing to use a small group. And you may remember some of the guys. It was Tom Riordan.

Katz: I know the name. I never worked with--

Cox: They're Intel.

Katz: Yeah, I know who he is.

Cox: Tom Riordan and Ray Kunita, they had left MIPS. They've gone Intel, MIPS. And they left MIPS when SGI-- this is not going anywhere for us. And they formed this design company. And then real

rapidly, MIPS said, "Well, why don't you work as an adjunct independent developer for us? And we'll round out our product line on the lower end and the desktop by using you guys as designers."

And they were being so successful. And Tom recognized it. He was an engineer at heart, a great architect. In fact, he developed the first-- he was the architect that did the first sixty-four bit processor, which was a MIPS processor. And they went to MIPS and said, "Look, this isn't working out. We can't build a big company doing this. We can't live on NRE. Why don't you give me a license? You've given license to a lot of other people. You don't want to build these circuits. And what you need is a supplier of these circuits. I'm going to go fabless. You let me develop. You give me a license, and I'll develop MIPS products for the market." And in fact, the-- little known to people, the most popular MIPS processor ever built, the R5000, that was designed by QED. And QED got a royalty from MIPS and SGI every time they sold one. So, it was a very, very interesting--

Katz: So, at this time your involvement was as a VC or as a consultant?

Cox: No, they-- so, at the time, they suddenly needed money to develop a product line, and market it, and put it into a wafer fab. Along came Weiss, Peck, and Greer and gave them the money. And then Weiss, Peck, and Greer said, "Wait a minute. There's no general management here. You don't know how to build a company. You've got no marketing. You've got no sales, none. You have no CFO. You're twenty-five engineers running a custom design shop."

And so, they came to me and said, "Would you be interested in taking over CEO," which I said no because I looked at a deal with Tom Riordan. I said I know Tom. But I said, "I'll tell you what I will do." And I had experience at this at Intel with the office of the CEO and the president. I said, "I'll go in as chairman, executive chairman if you want to call me that. Tom will be the CEO. And he can run all of engineering. I'll build the whole infrastructure. I'll build the whole company up." I brought in the sales VP. I brought in the marketing VP. I brought in the CFO. We brought in all the distributors. We put the whole sales organization in place. And then we were fortunate enough to become the chosen technology for HP's second generation laser printer and inkjet printer in Boise. And then everybody was using us in the printer business. And initially, you'll recall that Cisco had used the bit slice for the first Cisco machine. Then they went to, for second generation, they went to a MIPS architecture. And MIPS ran out of gas. And we took over the third generation just as they started to grow. And they went-- they committed a hundred percent to the R5000 and then the R7000, which was our own design. And the rest was kind of history. The year I went in as chairman, we did three million dollars. And the next year, we did forty-five million dollars between HP-- we took it public--

Katz: And was the idea of taking royalties, was that unusual at the time?

Cox: Well, yeah because there were very few independent design houses that were designing circuits.

Katz: Well, there were so many of them that all they did was they did a service for fee.

Cox: Yeah, that's right. But in this-- they were setting up their own company. I mean they set up a MIPS company. The difference was they didn't have to buy-- they didn't have to license cores. They were building their own cores. They had a license to practice the patents, which most of the MIPS licenses were. And they were selling MIPS compatible. And literally, that-- the whole rest of it was history. QED-- I joined-- the year I joined, we did three. The next year, we did forty-five. We took it public. And people talked about-- you can go back and look at it, it was 19-- it was the year 2000. We were the last semiconductor company to get out in the public market before-- And the day we went public, we priced at seventeen dollars. It closed that day at fifty-three. We went directly to a hundred in less than sixty days, a hundred dollars a share. And before the lockup was over, the six months' lockup for all the insiders, PMC-Sierra bought the company for three billion dollars, three billion, less than a year after I joined the company at three million dollars in total revenue. And again, it was a fortunate timing. I will take a lot of the credit for building that company. But--

Katz: Did you cook the deal with PMC-Sierra?

Cox: No, they came to us. It was a natural marriage. They were huge logic suppliers. They were the preferred source for wired-- all the Internet, wired. Wireless was Broadcom. But they were wired. But everything they had was fixed-function logic. They had no microprocessor and no logic capability in the programmable area. And they needed us. And also, they-- Cisco was by far their biggest customer. And Cisco, the only thing that ever concerned Cisco about us, we were small. And they started blowing in--

Katz: In somebody's ear to go find a company--

Cox: Well, the CEO's ear, "You ought to go over and talk to those guys." And that's how it happened. And that kind of positioned me with the venture world and I probably got more credit than I deserved. But that did do it. So, if you go back to when I left Intel, what's happened with my career now is that I've been on twenty boards. I've done five public offerings. I've done fourteen mergers and acquisitions and three secondaries. And I don't think anybody can claim they've done more than five startups, five public offerings. The fifth one, I just did this year, or did in November. But-- and in almost every case, the model was the same.

After the first couple of companies that I actually started with a blank sheet of paper, venture people who I knew from one company to the next company-- and one good example was the one you know is Pete Thomas. I just did-- the company that I just took public in November, Pete Thomas brought me on. He's on the board. He brought me onto the board. And he was a big investor. But the integrated circuit general technology startup world went through a phase where, in the latter part of the '70s, this is my model.

They'd fund a group of engineers. And when they'd developed a capability, and they'd demonstrate feasibility, the venture capitalists would come in there and bring in a new CEO.

Katz: And a marketing guy.

Cox: It very rarely worked well because you destroyed the culture of the founders. And many times, the founders-- they'd be very upset anyway. And they left. And suddenly, it wasn't working. And the venture guys will tell you that. And they moved-- started moving, in the '80s, into a deal about well, let's find some people who have demonstrated some track record who are maybe retired or semi-retired, and let's bring management team-- strengthen the management team, bring them in with the founders with shared responsibility where we could find personalities that can-- that's exactly what Tom and I did. We weren't even-- QED, for instance, we weren't even co-CEOs. He was the CEO. But I was the chairman of the board. And he understood what he did. And I was full time. They called me executive chairman in the model of Gordon Moore and Andy Grove, and Gordon Moore and Bob Noyce.

And I've done that now at almost all those twenty companies. And almost every one of them is identical. Since I left-- well, since I left Ateq and Weitek, I've never gone out and applied for a job. And it's-- the venture world has always come to me. The question you said, I'm quite proud of the fact I think the amount of technology that I've helped introduce to the industry that's still, whether it's in the name of the company, or it's in production today, I think a lot of it, it would have never gotten-- seen the light of day. It would have just-- it would have floundered or maybe come back years later because it would have never demonstrated its feasibility to where a bigger company took it over. And it's merely putting the right business context around it and helping build the organization.

Katz: Is your model, with your companies that you support on boards or as chairman, to identify a bright group of people, get them to make something feasible and attractive, and then get them sold?

Cox: Absolutely, except for the latter part. Although, the latter part is "then get them sold." I'm a huge advocate with the venture, and I think it'd be-- the feasibility of venture is as viable today because you can get a small group of people today and focus on a problem that's not being solved and bring it to market quickly. But you don't have the scale with a three trillion-dollar market where you could start up a semiconductor company and make it.

I believe the most successes for venture people in the future are going to end up the exit strategy is acquisition, not going public. And there's a couple reasons. Number one, the scale you've got to get to is so huge. Number two, it costs as much today to bring a product to market as it does to develop it. And we used-- and the cycle is taking longer and longer. I'm not talking about these social media companies. I'm talking about somebody that's developing a product. The cost of developing it is-- it costs as much to commercialize a product once they've got the product done as it did to develop it. And it's costing so

much money for the company that its cap table and its value is so large, it's awfully hard to breakthrough, then, as a public company. And it's much easier to be acquired and become a very important part of adding, wherever the hole is in a bigger company, and enhancing their position while they have the funds to support it.

Katz: Of all your companies, how does the sector demographics work?

Cox: Well, see the--

Katz: Are you all semiconductors? Are you all--?

Cox: That's the reason I feel so strongly about that. I've never known anything else. And every company, without-- one was a capital equipment company. But every company that I mentioned is a semi company. And laughingly, I think I hold the record. This is my sixth decade in the semiconductor business. I started-- really, you could say I started in '65 with the military. But I was at least at TI in 1969. And I've been without break, active management in TI-- in semiconductor companies now for six decades. So, I don't know anything else <laughs>. But it's been very, very exciting, very exciting. And I believe I'm contributing as much as the guy who develops the circuit because we can get it to market.

Katz: Show them how to make a business out of it.

Cox: Yeah, we can get it to market and bring that technology to bear on whatever the problem is.

Katz: So, that brings us to the point where it's time for me to ask, of all those things you just discussed for the last hour and half, which of them were the most satisfying and enjoyable to you?

Cox: Well, you know, I saw that question. I think the five IPOs. Now-- and by the way, I'm a big advocate. The people that say, "Well, I'm starting a company to take out an IPO," that's a bad--

Katz: Of course.

Cox: That's a bad strategy. But the-- what's the word I'm looking for? The fact that you can take a company public, that the public recognizes value in what was built--

Katz: That's a good scorecard.

Cox: I can sit here and say, "Well, look what-- look at how wonderful I did here," or "Look at what I did here is wonderful." If you're talking about a company like our country, and in a-- the best measure of economic success is somebody saying this company's worth this much money. And that is a real important factor to me because it demonstrates success. So--

Katz: Sure.

Cox: The other ones we've merged--

Katz: Ultimate scorecard is what they will ultimately pay.

Cox: Yeah, the ultimate demonstration of you accomplished -- what you tried to do was that you brought a product to market that is economically viable. And the fact that I've been able to do it five times, it's even better.

Katz: I've only done it once. But I had fun doing it, I have to admit.

Cox: No, it is.

Katz: Well, think about the other side of the story there. Of all the career junctions that you've had and decisions that you've made in driving your career or letting it drive you, was there anything you wish you had done differently, anything you wish you could have changed if you could go back in time?

Cox: No. You know that's interesting. I looked at that question. And there were individual companies that in retrospect you say, "I should have done my diligence a little better. I can name a couple. I don't want to name them, don't need to, that were just-- they were flawed. And it was quite clear that they were not going to succeed. And I was actually involved in helping them raise money. Probably if I had not been there, they wouldn't have even raised some of that money. So, I felt even a bit of responsibility to the venture world. But that's what they do.

But yeah, so I can talk about some individual companies that I have been involved with, particularly the younger ones, that I should have been able to-- I really believe that if I'd have done my diligence a little better, I would have been able to say, "No, this is a flawed idea. It's not going to work." And we wouldn't have done it. But other than that, no I really-- I really don't think so. That's why I'm still doing it. I'll be 74 in June. And there's not very many people my age that are still active board members or active management. And you know you had a question there about what would you advise younger people coming up--

Katz: That's going to be the final question, but go ahead. Answer it now.

Cox: This is pretty trite, but find out what your real passion is early on in your life. And then don't go away from that. You will never… I don't think at any salary or any amount of income, be happy if you don't have a passion for what you're doing. It just-- it doesn't work.

Katz: Well, there's passion. And there's skill. Any particular skills that you think they've got to build?

Cox: No, I think it varies from-- except commitment, except you need to understand the business you're in. And you don't-- you're not born with it. You've got to learn about it. You've got to understand the business. But in understanding the business, that's what builds the passion. And yeah, I suppose there has to be a certain amount of gray matter there, or you'll never get past the opening gate. But you see too many people; you see them in all big companies. They're all around. They ultimately end up there. And they kind of just are floating along. And then they retire. But they kind of go to work to make enough money to do what they really want to do. When I have a choice between-- and this sounds funny -- a company I'm working for and something else, I always put that first, not ahead of my family, no. But that's all right. It's just my wife and I. She's ex-Intel, too. But I think for anybody to really be happy and really to succeed, find-- I don't care how long it takes you when you're young -- find out what you really want to do. And when you say this makes me happy, then you're fixed. Then you've got a chance.

END OF THE INTERVIEW