Oral History of Jack Carsten

Interviewed by:
Jeff Katz

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Jeff Katz: Good morning. We are at the Computer History Museum on July 24, 2015. We're going to have an oral history interview with Jack Carsten. The interviewer is Jeff Katz. So we'll get started and say welcome, Jack.

Jack Carsten: Thank you.

Katz: It's nice to have you here. Full disclosure: Jack and I have worked together in the past. So I know some of what we're about to hear, but we'll get to some things I probably don't know pretty soon.

Let's start with your early life, Jack. Where were you born, how did you grow up, what kind of family were you in, and how'd you get educated?

Carsten: I was born in Cincinnati, Ohio, in 1941. The war was just about to begin, and my father was shipped off in the Navy for almost five years. My grandparents raised me on a farm until I was about five or six years old. Then my father, who was an IBM sales exec, proceeded to move around to half a dozen places in the country, and I got uprooted every couple of years.

Katz: So you got a chance to be a geography expert.

Carsten: Well, from my point of view, IBM stands for "I've Been Moved."

Katz: Indeed. Did you have siblings?

Carsten: Yes. I have one younger brother, who is now in North Carolina. We ended up living in the Midwest in the Chicago area, and that's where I went to high school and graduated from a famous high school called New Trier.

Katz: What were your best topics in high school?

Carsten: Oh, I think science, math, English. I was always interested in things that were sort of physical, and I was an avid Boy Scout, Eagle Scout. I liked to go camping and a lot of outdoor activities.

Katz: That's good. I guess you probably still do some of that.

Carsten: My wife doesn't like it.

Katz: All right. Well, after high school, you ended up at university. How'd you pick a university, and which one did you pick?

Carsten: Well, I had several acceptances from Ivy League schools, but I ended up going to Duke University in North Carolina for a very straightforward reason. The tuition was $1,000 a year, and since I had to pay for my own college, why, I was interested in-- let's just say the cheapest good place I could find.

Katz: Well, there must have been closer places in the Midwest, but Duke's a good place. And what did you study at Duke?

Carsten: Well, I was a physics major, but that was sort of an accidental thing. The Vietnam War was starting to heat up, and I became concerned about getting a draft deferment. And so, for that I needed a technical degree. I was good in physics, got A's in my freshman year, and so I charged off into physics.

Katz: Was there any other major or minor involvement at the University?

Carsten: The other thing that I minored in, actually, was economics. I had a professor by the name of Juanita Kreps who first introduced me to macroeconomics, what we would call quants today. She then became the Secretary of Commerce in the US government, and actually became quite famous. I followed her for some time. I thought that she was really stimulating.

Katz: Well, through your university days I presume you had some outside activities. Anything that our readers or listeners might be interested in?

Carsten: Well, those were the days when fraternities and sororities were important. So I was an active Beta. I was involved. I think I was on the [intramural] swim team, and some [other] athletic activities.

Katz: Duke's gotten famous for swimming teams.

Carsten: Well, not as famous as basketball.

Katz: Did you do any computer-type stuff in university?

Carsten: I remember programming the 1401 with decks of punch cards, and going down every night and having to sit at the card punch and peck away at that thing and turn in a deck of cards the next morning. We'd get a fan-fold printout that was probably 30 feet long or something, and try to figure out what it was all about. So that was sort of the nature of it.

Katz: Our viewers can't see me nodding, but I recall exactly the same experience, programming a 1401 to get my way through college.

Carsten: Yeah, so I learned a little FORTRAN and COBOL and whatnot. But that was-- when was that-- 1962 or something like that. It's curious that even though there were electronics courses in the physics department, there were no semiconductors being taught. There was a little semiconductor theory, but transistors were so expensive that all the labs were still done with tubes.

Katz: That's interesting. I was a couple years behind you, and I ended up with early transistors, and I thought they were just miracles.

Well, after university you took your first job, as I know, at Texas Instruments. How did that come about?

Carsten: Well, there were very few physics grads in my class of 1963, and so I was subject to quite a rush of offers. I think I had seven job offers, and my first question was, do you have a draft deferment? And so I had offers to go to Union Carbide Nuclear and work on A-bombs, to go to Westinghouse Bettis, which is in Pittsburgh, and work on reactors for submarines. I had the chance to work for IBM Huntsville, which was building the rockets for the space program and the Minuteman and so forth.

And then I had an interview at Texas Instruments, and I really liked the weather in Dallas. This was a much smaller company, and they seemed like a lot better place than Oak Ridge, Tennessee, or Pittsburgh, or-- some of these other towns were just awful. I was married then, and we made a quick decision to go to Dallas.

Katz: Interesting. The Midwesterner decided to become a Southerner.

Carsten: Right, right.

Katz: At TI, what was your first assignment?

Carsten: My first assignment was chasing spare parts around for a sonar system. And I had the draft deferment, all right, but it wasn't the job that I had been hired for. TI lost the contract for the SHRIKE anti-radiation missile between the time they made me the offer and the time I arrived in Dallas.

And so after doing that for a year, I found out about a secret program that I volunteered for. I had the clearances and so forth. And I joined the development of the ELINT computer for the YF-12A Blackbird, the famous spy plane that overflew Russia and so forth and so on.

And that was one of the very first applications of integrated circuits into a highly dense computer. We were building a computer basically for radar discovery that was about the size of several cigar boxes, at a time when most computers, if they didn't fill a room, at least were large boxes. And it was quite a challenge. I was a product engineer and worked on the packaging and the testing and integration of this thing.

Ed note: after the interview, I received a photo of the computer and it's application, so I corrected the reference. It was not for navigation. But it was 53 years ago!

Katz: How big a team was on a project like that?

Carsten: Boy, I would guess 30 or 40 people. We all worked for Jim Clardy, who later became the CEO of Cyrix, down in Texas. I've sort of stayed in touch with Jim. But anyway, I did that for about a year and a half, and it became pretty clear to me that at least at TI, the exciting part of the kind of project I was working on was actually the integrated circuits. And so with the help of a friend, I was able to transfer to the integrated circuits department.

Katz: Still doing product engineering?

Carsten: No. The only opening they had was in product marketing, and so even though I really wasn't a marketing guy, I went over and said OK, I'll do this. And I became the first product marketing engineer for TTL integrated circuits. Which, as you know, became quite a large business.

Katz: I was one of your customers. How long before you got into the semiconductor part of TI?

Carsten: I was in the military equipment group from '63 to '65. And then I was the product marketing engineer for TTLs for I think another two or three years. I became pretty proficient in the development of what at the time was called MSI, which stands for medium-scale integration. Up to maybe a hundred gates or so. A hundred gates!

Katz: What does it mean by being proficient in the development of it? Designing the circuits? Defining what logic functions they ought to have?

Carsten: We were defining what MSI circuits TI would develop. And in doing so I'd go out and meet with the customers and figure out what configurations were common and they wanted. We were building arithmetic units, shift registers, various kinds of memory arrays, and a bunch of logic functions.

Katz: In doing that, did you draw on your earlier compact system experience, or were you more listening to what the customer they wanted?

Carsten: Well, some of both. But in any event, that job led to an opportunity to work in a new group for Jack Kilby, who was one of the inventors of the integrated circuit. And in that group we were trying to sell what we would now call an ASIC. But it was a full slice, or what on the West Coast we call a wafer, a full

wafer, of TTLs that were discretionarily interconnected using E-beam [writing] in order to create a custom circuit that would produce very, very dense logic.

The idea behind that was to produce even more dense computers than I had worked on on the YF-12A.

Katz: I'd like to explore that a little bit more. But I want to go back just a minute to the TTL part of your time with the MSI. As a customer, I was always impressed with what TI was able to come up with, that big yellow book of all those various circuits. How big a group was that, and what was your role in it?

Carsten: Well, when I joined that group in 1965, I think the entire market for all integrated circuits was about $100 million. And the large bulk of the business was military, and a lot of the chips were being sold for the Minuteman missile, the various space programs. Generally speaking, it was viewed as a very expensive specialty product. Once the TTL product came out, the plastic dual in-line package was developed, and we started building more complex functions at some significantly reduced cost per function.

All of a sudden TTL became viable, in fact attractive, for commercial applications. We sold a lot of product to Digital Equipment and Friden and a lot of the calculator people, NCR and so forth. Not so much into mainframes and larger systems, but medium-sized computers all of a sudden became a big piece of the market.

Katz: Right. So within TI, was that becoming a major group?

Carsten: Yes, it was. It was the most popular of the logic groups. They had RCTL and DTL and various kinds of logic. But the TTL was always popular.

Katz: Was it well-populated within TI, with staff?

Carsten: Well, that's sort of the next part of my story. Because after going to work for Kilby-- and I think I worked there less than a year-- the vice-president of the semiconductor division then, a fellow by the name of Fred Bucy, decided that they had too many employees in Dallas. And indeed, I think they had like 70,000 employees in Dallas, mostly building regular transistors and other things.

And so he decided to move all the fast-growing operations to Houston, most notably the TTL division and the MOS division. And so as a bunch of ex-military people, which was what the background of the top management was, they just hauled us all into a room and announced "You're moving." And this was not well received.

As a result, most of the key executives in the TTL and MOS divisions resigned. And there's [been] quite a lot been written about L.J. Sevin and the top 10 or 15 people in the MOS division at the time. They all resigned and formed Mostek. There were several other start-ups that all were fired up in the Dallas area as a result of this-- to my way of thinking-- pretty stupid decision.

But I was approached then, even though I wasn't any longer in the TTL group, to see if I would move to Houston and run both marketing and product engineering, both of which I had experience with, which was a group of perhaps 25 people or so in Houston.

Katz: They were already there, or did you have to drag them?

Carsten: Oh, no! I had to-- I mean, that was the size of the group, but I had to find them. And in fact I ended up having to recruit a lot of people, because a lot of people didn't want to move. But I think when that group moved, it was about $30 million a year in revenues. And within four years or so it had grown to almost $400 million in revenue.

Katz: That was in spite of or because of the move?

Carsten: I would say in spite of the move.

Katz: Well, that's a pretty good growth rate. It must have made you a hero in the company, or at least part of the hero team.

Carsten: Well, within-- I don't remember, a couple of years-- they asked if I would become the GM of the TTL division with all of the other groups reporting to me. And back in those days, that included the wafer fab. For example Al Stein was my wafer fab manager.

Katz: He was a bipolar guy originally, huh?

Carsten: Oh yeah, he was a bipolar guy. He later became the CEO of VLSI Technology. And I hired Barry Cox as my marketing manager, and he joined me again at Intel and has since been the CEO of Weitek.

Katz: Was Barry hired right out of college, or did you have to steal him from someone else?

Carsten: No, I hired him when he was an Air Force procurement officer with a military background. In fact, I think he graduated from the Air Force Academy. So that was his background. We really were able to attract a lot of good people, and I would say [that was] a very pleasurable part of my career, because we developed what we call the treadmill strategy. Which is that all the products that we were shipping, in particular the simple products, the gates and flip-flops and so forth, we sold most of those at cost. So for example, we would sell a TTL quad gate for $0.15. On the other hand, an MSI which might only have 100 gates in it, we sold for $5 to $10.

The purpose of this was to get the other suppliers, like Motorola National, Signetics, Fairchild, to copy our MSI products so they could share in the profits. But as soon as the product was copied, the price dropped to, let's say, $0.50. And then the next new product came out at $5. The customers, soon becoming accustomed to this, had no reluctance to design in our $5 product because they knew that lower prices were coming and we were projecting lower numbers and so forth. But the competition never could seem to make any money.

Katz: Right. They were always at the $0.50 point.

Carsten: On the treadmill.

Katz: That's not the only company that ever successfully operated that way, is it?

Carsten: Well, but it may have been one of the first.

Katz: Was that one of your personal innovations?

Carsten: Well, along with [help from] some others, certainly. Along with Barry and the rest of the TTL team. Now, one other thing that we did that was quite innovative at the time was that the bulk of the sales were through third-party distributors. And we set up for TI-- along with Ed Gelbach, who was the VP of sales at the time-- an extensive set of distributors. Because of all these monkeyshines with respect to pricing, for the first time we offered “price protection” to the distributors, so that if they had inventory of a $5 part and we dropped it to $0.50, then they were issued a credit for the difference in the distributor cost from before and after.

None of our competitors did this, and in fact you have to take quite a large financial reserve to be able to do this. Yet when they were caught on the treadmill and their distributors were screaming that they had

basically been stuck with all this high-priced inventory, the net result was that the distributors much preferred to do business with us. Yet the cost of changing to that strategy, if you hadn't been [already] using it, is in fact enormous and would show up on corporate quarterly reports and so forth.

Katz: Whose bright idea was that?

Carsten: Well, that was one of my ideas. So, you know, technology is one thing, but price protection is something else.

Katz: Well, of course. You've got to play both sides. I was always curious. There were two parts to the TI TTL business that I always observed, which were the military 54 series and the commercial 74, which all had the same functions. They had a price difference of 2 or 3x or 4x or whatever it was. Were they really just all the same part with different yields?

Carsten: Sure. The primary difference was that back in those days the military would not accept plastic packaging. And so the military [parts] were all either in metal flat packs, or we did make some ceramic sandwiches and other hermetic packages. And of course they had to operate in a broader temperature range than the zero to 70 [degrees] series 74. But as a practical matter, most of the chips-- we didn't really lose any chips [at military temperature testing].

Katz: Design them for the military and use them for both?

Carsten: Right.

Katz: Very interesting. That was my suspicion all along. And the price difference always seemed to be because you could do it, because the market could bear it.

Carsten: You know, that was the [temperature] requirement that they had for the mil-spec packaging.

Katz: Right. Well, I'm certain the packaging and the temperature made it somewhat more expensive to make. But possibly not four or five times as much.

Carsten: The other thing I would say is that back in those days the military business was still a very important part of the TTL business, and I think of most analog and other. It was a significant part. Maybe 30%, 40% of the business.

Katz: OK, well, let's go back now. Thank you for the deeper background on the TTL. Can you come back into the part of your time where you were doing the dense-- the ASIC-type stuff?

Carsten: Right. That was called the Customer Requirements Center, and we were trying to sell this stuff mostly to the military. But from my perspective, it was a bit of a science project. The reason was that although you could successfully discretionarily wire 200 or 300 gates together into a custom configuration, the yield was very low. We were lucky if 10% of the wafers worked. Or 5%, or 2%, or some crazy numbers.

And so the reason we were going after the military is they were the only ones that could afford the expense of doing this. And as a practical matter, it wasn't that much more dense than the kind of stuff that we were doing in the YF-12A days, particularly if you used MSI in [small] flat packs.

And whereas Kilby and some of the management there felt that this was going to be the wave of the future of how all semiconductors would be built, it was basically an economic flop. The secret of the high-density chip turned out to be MOS, not full wafer bipolar.

Katz: Yeah, well, you can't fight the laws of physics. There's got to be a few defects somewhere on that wafer.

Carsten: Yeah, and the other problem-- as you might imagine since this was bipolar-- is these things burned a hell of a lot of power.

Katz: No matter what gates were wired together, all of them were consuming power.

Carsten: Right. But it was an opportunity to work for Jack Kilby, who was actually a wonderful and amazing scientist just bubbling over with ideas for everything from new packaging to solar cells. I mean, he was one of the people that came up with the idea for the Speak and Spell [handheld game], for example. He had just a wealth of new ideas.

And he was very well-organized. It was the first time I had worked for-- I would just say a really well-organized senior executive, and I learned how to--

Katz: This was before the Nobel Prize, right?

Carsten: Well, yes. Oh, yes. Quite a bit before the Nobel Prize. They were still fighting over who had invented all this stuff. This was in 1967 and '68.

Katz: Was he an acknowledged hero within the company at that time?

Carsten: Oh, yes.

Katz: so, I presume, he got to do sort of whatever he wanted?

Carsten: Well, he was basically-- yes, assigned to work on the more speculative projects.

Katz: Well, that's quite an opportunity for you to be tagging along for a while, too, I suppose.

Carsten: Well, then later when I was at Intel, I worked for Bob Noyce. I think I'm the only person that ever worked for both Kilby and Noyce.

Katz: How long did that activity last before TI saw the light and said, this thing's not going to be economically viable?

Carsten: Not very long. A couple of years. After I left, I think it was wound down within a year.

Katz: So what caused you to leave? You saw that writing on the wall?

Carsten: I had this [Houston] opportunity to be-- my first opportunity, really, to be a substantial supervisor.

Katz: Oh, I see. That's where you started recruiting Al Stein and Barry Cox and all the rest of them.

Carsten: Exactly. Right.

Katz: OK, so an opportunity comes by, you snatch at it, and leave behind in the dust the less successful business and went to the more successful one.

Carsten: Right.

Katz: How long were you running that business?

Carsten: Well, I think-- I ran that business from 1969 until 1973, and at that point I was asked to move over and run the MOS division of TI, which at the time was mostly an R&D function. They were starting to build DRAMs-- having a lot of problems there, as Intel was at the time also. They were [also] doing some CCDs.

And then they were doing, rather successfully, the early MOS logic chips. They built quite a few chips for the hand-held calculators that were built originally by Bowmar. And then TI built them themselves.

Katz: I was a customer for that thing too. The TI 5100 calculator.

Carsten: The MOS business, [at that time] there was almost no military business. It was mostly a consumer-oriented business with a lot of technical struggles. Charles Phipps had moved to Houston and was running that business. He was not very happy. And so I took over from Charles.

Katz: You had already worked for him.

Carsten: I'd worked for Charles. Charles was my boss when I first went to the integrated circuit department. He later became a VC at Sevin Rosen, and he's still around. CHM did an oral history on him. He's quite an interesting guy. He knows a lot more about TI than I do. He was there for his entire career.

Katz: So MOS division. Of course, when they ask you to do something, you usually say OK. Was there any enticement there-- I mean from the point of view of that business versus the TTL? Did you view that as a nice opportunity?

Carsten: Well, it was, at the time, a smaller business than TTL. I guess I had some inkling that it could become a big business. As we know, it became a much bigger business over a length of time. I didn't have great inspiration at the time for what the DRAM was going to become. It seemed to me to be a wish-and-a-prayer sort of—[product].

Katz: This was when? '

Carsten: This was from '73 to '74, I guess, that I was there. It seemed to me, at least at TI, that there were just an awful lot of problems and you had to keep kicking this thing every few milliseconds or it would die, and I just had a hard time seeing how--

Katz: Yes, you're right, there were system issues like the refresh issue. But there were also variable yield issues in the whole MOS industry.

Carsten: Right. The other problem was that you'd build these things and put them on life test, and in three days half of them had died. And you had all these clean oxide issues. So there were lot of issues there.

On top of that, I had a lot of problems running that division because of some politics going on at TI at the time, where there was a great fear that the company was going to be unionized. As a result of that, Fred Bucy put out an edict that any cutbacks were to be prioritized based on seniority by site.

Katz: Which is exactly what unions want.

Carsten: Exactly. And so in 1974 a recession came along, and the systems division of TI, which was commercial systems-- which was co-located on our site-- had a big cutback, and had difficulty selling their

minicomputers. They never were that big a factor in that business. And so they laid off several hundred people.

Now, the MOS division was the youngest division. And in particular, we had recently hired and trained a lot of people in the wafer fab, what they call the “front end” at TI. And so when they laid off these people over in the systems division, they sent them all over to me, and told me I had to lay off all my front-end people that I'd just trained and bring in all these old chickens that were used to, you know, soldering, and had no idea--

Katz: "What's a clean room?"

Carsten: Yeah. "What's a clean room? What's a bunny suit?" And so forth. And I went through that not once but three times, as a series of rolling layoffs caused me to repopulate the MOS fab. And it just killed our yields. Everyone was just tearing their hair out.

Katz: That probably explains my sense-- at the time, I was still a customer just trying to get my boss to let me use DRAMs, but he didn't. Anyway, I was watching the industry pretty closely, and it seemed to me that Intel, when I talked to them, were more scared of TI than anyone else. They weren't scared of the Japanese yet. They weren't scared of any other competitors. But Intel was-- always looking over their shoulders. "Is TI going to get us on DRAMs?" But TI never did. And maybe that was part of the reason.

Carsten: Could have been. Could have been one of the reasons. In any event, that sort of leads to the next phase of my career, because in late 1974 the former VP of sales at TI, a guy by the name of Ed Gelbach, approached me and asked me, would I be interested in going to Intel.

I'm sure part of Ed's motivation was not only to bring in a good person to his start-up, but also to “defang” TI in the area that they were most worried about.

Katz: That could be.

Carsten: And in fact, when I finally left and went to Intel, TI had a very strong policy of not hiring senior executives from outside. And the executives that were promoted to replace me really were not very strong. You're back to the same problems they had all along. Most of the good executives were in Dallas. Most of the Dallas people hated Houston. And so it was very difficult to find good people.

Katz: And there was not a younger version of Jack Carsten to step into the breach?

Carsten: Not really. Glen Penniston ran the division for a while and then left and went to AMI, and I think they had four or five people running it over a period of time that was quite important. It was the period in the early and mid '70s when, of course, the memories and everything else in MOS became quite significant.

Katz: All right, Jack. You've had a good time at TI for quite a while. Tell us a little bit about the major lessons you might have learned there that served you well in the later part of your career.

Carsten: Well, I mentioned earlier the significance of pricing and distributors and a lot of other sort of sales and marketing-related things. There was something else that TI pioneered in that I think was quite important. They did a large research project with the Boston Consulting Group where they examined what was called then-- and still is for the people that remember it-- was called the “learning curve”, where we determined at what rate it was likely that cost would come down for semiconductors as complexity went up.

And while Gordon Moore and Moore's Law and all that sort of thing is getting a lot of publicity, the early work that was done that resulted in forward pricing and all of those sorts of strategies, was work that was done at TI. I became quite an advocate of that kind of thing long before I even knew Gordon Moore. So I think that the strategic part of TI, and the work they did on strategy, was quite good and really had a lot to do with their growth.

Katz: What you've described is mostly market strategy. Any other business strategies that served you well later?

Carsten: Yeah, they had a rather formal strategic planning process which was called OST, which stood for objectives, strategies, and tactics. They started at a high level with what the company's objectives might be in semiconductors, for example. Supplying chips to mainframe computers [for example], which at the time was not a big market for ICs. And then they would go down to specific strategies as to how they were going to accomplish this, what chips would be developed. And then detailed operational tactics, which then led to the budgeting and the planning for the company as to how R&D was going to be allocated.

Katz: At what frequency were those plans developed? Was this every week, every month, every year?

Carsten: The OST system was an annual sort of review that set the budgets and the plans. But this is what led to the process of how they prioritized R&D, and how all that work was done. They were also another group, [who] like Intel, had most of the R&D done in the divisions. There was what they called SRDL, which was a central R&D function. But that was mostly device physics, and the development of new architectures and of the concepts for everything from new packaging to MSI, LSI. Those sorts of things were all done [in the divisions] through this OST system.

I think at the time that was both a focus for the company and one of its strengths. Because if I recall, the major competitors that we had at the time, like National Semiconductor, Fairchild, Sylvania-- Motorola was a big competitor-- I think they had inferior strategic planning systems. The only one that even got close was Motorola.

Katz: Well, ultimately TI became the model for much of the industry. Especially-- well, I don't know about the planning, but I know that forward pricing strategy became business school case studies for many people.

Carsten: And of course it's been written, and properly so, that Bob Noyce was the father of that strategy back in the early transistor days at Fairchild.

Katz: Interesting. Did you have any particular mentors or teachers at TI that influenced you in later life?

Carsten: One mentor stands out above all the others. When I became the division manager for the TTL division-- in 1969, I think it was-- I then worked for Morris Chang until I left. Morris was an absolutely terrific manager, very tough and demanding, in many ways similar to Andy Grove. Perhaps not as well known as Andy, but extremely well-organized and very supportive of a young GM. At the time I was only 30 years old, and so to give me all that responsibility-- I had 1200 people working for me, running a $250 million division. It was terrific.

Katz: What was the nature of that relationship? Did you meet with him frequently, or did you get guidance from him once in a while? Did you get your hand slapped?

Carsten: Well, he was in Dallas and I was in Houston, and so to a certain extent that was an advantage. I remember a lot of flights on Southwest to Dallas to go and attend his staff meetings and one-on-ones and things like that. But I think unlike some of the other TI management, he both understood markets and

strategies and in addition was a PhD EE that understood a lot of the physics and the underlying technology. So he really, I think, was one of the finest managers that TI had.

Katz: Yeah, he's well-respected in the industry, as we know. And I guess you're fortunate to have worked with him, and with Kilby.

Carsten: Right.

Katz: OK. Let's get to the end of your time at TI. What made you ever decide to leave, if you were doing so nicely there?

Carsten: Well, the former VP of sales at TI, Ed Gelbach, had gone to Intel a couple of years earlier. And he approached me to take his job as the VP of sales and marketing at Intel. It was very attractive. Intel at the time was viewed as a darling. Moore and Noyce were already very famous. And so I went out to California and talked to them.

My wife was very interested in moving to California. She never really liked Texas.

Katz: Where did she grow up?

Carsten: She grew up in Philadelphia.

Katz: That might explain it.

Carsten: But both of us had been in Texas then for about 15 years, and how shall I put it? She was not a Southerner.

Anyway, the offer was attractive. It wasn't exactly my background. I had never been a salesman or run a sales organization. But it was an attractive offer. And so I went back to Morris Chang and said, "Look, you know, I think I want to leave." And the first thing he did was promote me to the site and division manager of both the MOS and TTL arrays, and all these sort of counter-offers and everything. But in the end, I decided I wanted to go to California.

An interesting anecdote which sort of gives you a feeling for TI, is that as soon as I made that announcement, Fred Bucy jumped in his Learjet and flew to Houston, and didn't tell anyone, including me, that he was coming. The first I heard was when the guard at the front desk called and said, "Bucy in the building." The next thing I know, Fred Bucy, the big boss, the president of the company at that time, comes running into my office saying, you know, "What are you doing? You're crazy to go to California. Would you want to raise your children in a terrible place like that?" I remember asking him--" Well, Fred," I said, "it's a very attractive offer, and I've gotten this stock option. If I really did well at TI and became a top executive there, would I ever get a stock option like this?" And he looked at me and he said, "No way in hell."

Katz: Well, that's a good way to save a departing employee!

Carsten: So he wasted that trip to Houston.

Katz: I guess you had the right answer.

Carsten: Yeah.

Katz: Were there any other major frustrations with the company? There's some push and some pull, when you make a job change. I understand the pull. Was there any push? Anything that you were just upset with, or wasn't going right for you, or you didn't think it would go right in the future?

Carsten: The primary problem was the micromanaging of the top management. This was Fred Bucy and Mark Shepherd, who for example—(Morris Chang told me later), he would be called into their office and they would have an org chart of his organization up on the board and marking it up and moving the people around like pawns, and hand it to him and say OK, this is your organization starting tomorrow. Please go out and announce it.

And there was no point in arguing with them. They had a military background, and if you wanted to make somebody the general, you made him the general. So that kind of thinking, as well as the labor problems that they created, and a number of other dictatorial policies-- for example moving everybody to Houston and then to Lubbock, and a bunch of other let's just say minor towns in Texas-- were some of the reasons why TI did not do very well after I left.

Katz: Before we get onto the next phase, I want to just recap a little bit. You've pointed out a few of your major accomplishments at TI, of which you ought to be proud. The growing of a large business from a much, much smaller one, including both the market size and the staff to support it. The pricing and distribution strategies were all kind of innovative and useful in the industry, and they ultimately got emulated by many others, I believe.

Did you have any other major frustrations there? Or, what major problems did you have to encounter and solve while your life at TI was going on?

Carsten: I don't really remember challenges other than recruiting was always a tough problem, even though we had a growing business. Getting good people, particularly [getting them] to move to Houston, was difficult. It's not different than in my venture business, where you've got a start-up located in a, let's just say, undesirable place. Getting people to move is always tricky. And TI didn't really have a strong incentives program, a strong stock option program, and a lot of the other things that you have in Silicon Valley.

Katz: So, recruiting. Any other major issues there? Technical?

Carsten: Well, there were a lot of technical issues. I think the ones that I worked on and spent a lot of energy on were more packaging issues than anything else. We had a lot of problems with plastic packaging. We had a lot of reliability problems. The military business was quite important, and we had a lot of difficulties negotiating the specs on those kinds of things. So I remember difficulties that seem minor now. But at the time, those were very important businesses, because the military was a very profitable business for us.

Katz: As a division manager or product line manager, did you have frequent and intense engagements with customers, or were you mostly in the back room making things happen?

Carsten: I spent a fair amount of time with customers. I remember that Digital Equipment was a big customer, and IBM was a big customer. We sold a lot of TTLs to IBM for their medium and small calculating machines. And one of our big wins was when we convinced IBM to use plastic packaging, because they didn't use any plastic packaging in their internal manufacturing. But they were reasonable about it. I would say that was my first involvement with IBM at some fairly high levels.

Katz: Well, let's move along now. Ultimately, you got this nice offer from Intel and went there. How did you find Intel to be?

Carsten: Well, it sounds like a big deal being the VP of sales and marketing. But at the time, if I recall, there were 29 people in the sales organization, and 26 of them were in customer service. Mostly clerks.

Katz: What year was this again?

Carsten: This was in early '75.

Katz: What was Intel's revenue size at that time?

Carsten: I would say their revenues were less than $100 million.

Katz: The whole company? Really?

Carsten: Yes. And in fact, in 1974, which was a recession year, it was a terrible year for the company. The stock fell from $80 to $18. I was supposed to report at the first of the year, but I suffered a kidney stone-- a problem I still have-- and so I couldn't report to work for almost two months.

Katz: So that must have meant you got a lower priced stock option.

Carsten: No. During that period the stock recovered from $18 to $30, and I couldn't convince Roger Borovoy to give me the option price. When I signed the offer he said you have to have [actually] reported to work, or some such stuff.

But anyway, it was a terrible time for Intel. In the fourth quarter of 1974. Why, bookings were negative and revenue kept declining.

Katz: Because of more cancellations than shipments?

Carsten: They had more cancellations and returns than they had-- that was a tough year. We were still a functional organization, and pretty small. I think there were maybe eight or 10 people in various parts of marketing. Bill Davidow, Dave House, a lot of the people [whom] you know in one way or another were in marketing. But it was not a big organization. And one of the first things I had to do when I got there, was to build the organization.

Katz: You said it was functional. That means the individual product areas did not have their own marketing?

Carsten: No. We had an engineering department that was run by Les Vadasz, manufacturing by Gene Flath, and I ran sales and marketing, and Gelbach was the head of the semiconductor group. Then we had a systems division, but that was it. So everybody worked for one of us. And of course as you know, not long after that we spun out the microcomputer business, and Davidow and Vadasz then ran that business.

Katz: That's when I joined, shortly after that.

Carsten: And so it wasn't too long after I got there that we started divisionalizing.

Katz: Was that part of your or Gelbach's recommendation, or did it just seem the right thing to do as the business was trying to grow?

Carsten: I think Noyce was the biggest driver of trying to create a business out of the microprocessor. Many of us felt that the number of customers for a microprocessor was going to be small. If you say, well,

a microprocessor is going to be used in minicomputers, I think there were only like 20,000 minicomputers a year being sold, and so how can you make money building 20,000 chips?

So that was sort of the conventional wisdom at the time. And some people-- and I think Bill Davidow, was the visionary on this-- felt that it could be much larger if you had the customer do the software development and the configuration and design. That was a very different concept than they had at TI, and it was one of the reasons in my mind that TI never became an important factor in the microprocessor business. Because at TI, they had this view that all of the software and system design had to be done within TI. So when they took a contract for let's say some consumer product, or a calculator, a small business thing, why-- they did the whole thing. And obviously the microprocessor could never have become a big business if you tried to do that.

Katz: Were you at Intel at the time when the Busicom business showed up there?

Carsten: No, that was a couple years before I arrived. Although if I recall when I arrived, Shima and Ungermann and a couple other of the execs had left and started Zilog. There was a lot of turnover at the time, because as I mentioned, Intel had a terrible 1974. I remember calling my stockbroker and saying, am I making a terrible mistake here? Is this the Titanic or what? And so I think a lot of pretty good people left Intel about the time I arrived.

Katz: OK, you got there, and shortly thereafter they divisionalized somewhat. After '75, the bad year. '74 and '75, it was a pretty much straight upward path for a while, wasn't it?

Carsten: Well, the memory business was quite successful. The early DRAMs were, although we had strong competition from Mostek, and in some ways the Mostek parts were denser and better parts than Intel's--

Katz: Yes, they won the pin-out war at the 16K level, with smaller packages.

Carsten: Yeah, right. But nevertheless, the various memory businesses were quite successful. And that was not only DRAMs. EPROMs were a big business, and we built a lot of ROMs back in those days. SRAM was a big business.

Katz: Was the memory systems business going by that time?

Carsten: Yes, the memory systems business started out as a way to get rid of reject DRAMs.

Katz: I remember, we called them floor sweepings.

Carsten: Right. The 16K DRAM had absolutely terrible yields, and half of them, one side or the other of them didn't work and they were really only 8K RAMs. So we came up with this idea to "sell" them to the memory systems division, who would then put together what we called partials into boards and ship them out as systems.

Most of these systems were leased, back in those days, and the bulk of the business was what was called add-on RAS for IBM 360 mainframes.

Katz: So Intel at that time was going into the leasing business?

Carsten: Yes, and that was a problem for them. Getting the financing to lease these systems that were full of, excuse me, junk.

Katz: We always thought it was remarkable, that we could get rid of the floor sweepings. People paid money for it, if you package them up pretty and put a little software on it to ignore the bad parts of the chips.

Carsten: Right.

Katz: The other interesting memory business that I observed as I was coming into the microprocessor side-- watching the memory side, which was paying the bills-- was the IBM Caribou. Were you involved in that?

Carsten: Yes.

Katz: Please explain a little bit about what that was, and how it went.

Carsten: Well, IBM was interested in buying Intel DRAMs. I had a long history with IBM, and frankly Moore, Noyce and Grove were not very positive about working with IBM. But I became kind of the internal IBM champion. And we convinced IBM to use our DRAMs, but the 16K was not dense enough for them.

So we came up with what seems to be kind of a stupid idea, where we put one DRAM on top of the other. They were in dual in-line packages. And we soldered them all together, so you had two packages on top of each other in a single configuration, which then IBM used [in] this piggyback configuration. It was called Caribou.

Katz: How did they address this-- keep them separate?

Carsten: I don't remember if the two chips were actually-- had a different addressing configuration, or were bonded out differently, or exactly what. But obviously they couldn't [both be selected at the same time]-- they would short each other out if they were totally identical, so I think we bonded them out differently for the two different versions. But we sold a lot of that stuff. I mean, we're talking about millions of dollars.

Interestingly, the memory systems division also ended up selling a lot of product to IBM. And the story behind that is most unusual. In I believe it was 1978, IBM came to us and said, we can't build enough RAS to meet our customers' needs. And so we've come up with a strategy to solve that problem. We are going to replace all the 360 RAS that's used in IBM facilities around the world with your RAS systems. With Intel's--

Katz: That's their own internal systems that they used. Not the ones they sold to customers?

Carsten: Not the ones they sold to customers. They were going to replace all their internal systems. And then, since these were leases, they would then ship the boxes from their internal systems to their customers and lease them to the customers, and then they would use our systems [internally]. But of course they said IBM on the outside, they were in the same box, and so forth and no one was supposed to know they were really Intel DRAMs in there. They made us sign some documents [such] that we would swear this whole thing to secrecy and no one would ever know and so forth. Only we sold them a lot of product. If I recall, it was like an $80 million order. It was a huge order for us at the time. The company was only doing about $400 million. So at the end of the year our auditors, Arthur Young, said wait a minute, this is a material sale. You've got to reveal what this is, and who the customer is, and so forth.

And so we went back to IBM and we said, “oops. Our auditor says, da-da-da.” They used the same auditor. It was a great brouhaha. And finally they said, “OK, so you've got to reveal it.”

Well, as soon as we revealed it-- why, sales of our memory systems, now blessed by IBM, shot up. And the stock shot up.

Katz: But IBM must have been not very happy.

Carsten: IBM was very unhappy about it. But at least they couldn't blame us. We kept it a secret as long as we could. But it was the first really major engagement that we had with IBM of a strategic nature. Long before the PC and all the other things.

Katz: Well, as I recall the microprocessors were selling in fairly small numbers at that time, they weren't yet thriving and making a lot of money. The development systems were, so there was always the future there, but not the microprocessor product itself.

Carsten: We sold a fair number of 8-bit microprocessors to IBM. They had a system that actually I had in my office, called the Displaywriter, which was basically a word processing system that used the 8085. It used the old big eight-inch floppy disk, and it was sort of a glorified typewriter, if you will. Kind of a precursor of the PC. I think it sold for $18,000 or something like that.

Katz As you progressed in your time at Intel, marketing and sales were doing OK. And the concept of field support became more and more important as the microprocessors developed, and the customers needed help to develop their software. Were you engaged in part of that?

Carsten: Sure. The development of the field sales organization and the establishment of our international operations was a big part of what I was doing in the late '70s. Both hiring and filling out not only the direct sales organization, but the applications engineers, the distributor chain, and for that matter, the partners that we needed for second sourcing and other kinds of things. So yes, I was involved in all of that.

Katz: Please explain a little bit about the development of what became a crack sales force and customer support capability, because I think that's exemplary in the industry.

Carsten: Well, in 1979 the microprocessor business-- Vadasz was running the microprocessor components business, and Davidow was running the microprocessor systems business. And at that point Andy Grove decided that he wanted me to run the microprocessor business. And he moved Davidow into a sales role, and he and Gelbach took over my old [sales] role. And I ended up working for Andy Grove thereafter. That was the time when Davidow, Gelbach, House, a number of the key Intel executives, started this Operation Crush program, where the goal was to win 1,000 designs for Intel microprocessors. It was quite an ambitious goal. This happened, I think, in 1980. I have to give them most of the credit for what came after. But a lot of policies and programs, incentives, rewards, special distributor incentives, all kinds of things were put in place to do this.

And as we know, it was quite successful. It was at a time that the Intel product line was being superseded by the Motorola 68000, and for that matter Zilog and other people. And so it really was a turnaround for Intel.

[EDITOR'S NOTE: Just before program launch, Davidow insisted on raising the design win goal from 1000 to 2000. And at the end of the year long campaign the actual count turned out to be about 2500 wins.**]**

Katz: Did you have a personal engagement in that Crush program?

Carsten: Well, I was running the division, and so my role was to supply the picks and the shovels that were needed to make it all happen. But the sales organization was running it. And I would say the other

personality that was very, very key at that time was Regis McKenna, head of our top-notch advertising agency.

Katz: Indeed, he was well-entrenched in Operation Crush. : My personal opinion is it was he and Davidow and Lally, with a bit of help from House and a few others of us. But those three were the big creative sparks behind Operation Crush.

Carsten: Yes.

Katz: As you were running the microprocessor business, did your life change much? You had your IBM connection, which I suspect you could have exploited or helped Intel to exploit. But it's a much different business than the memories that you had been working on.

Carsten: Right. Well, from my perspective, and back to some of my TI days, I really enjoyed building businesses. And so during that period while I was there, we built many logic businesses that subsequently became quite important to Intel. The one that receives most of the publicity, of course, is the microprocessor business, the x86 and its progeny. But we also set up the microcontroller business, the telecom business, the military business. There were quite a number of others. The peripherals were quite significant and important. All of those were business units that reported to me and generally speaking were created during that period.

It was also a period of geographic diversification. We moved a lot of those businesses to Phoenix. The microcontroller business was moved to Phoenix, and then I recruited out of the R&D labs a sharp PhD by the name of Craig Barrett and put him in charge of a business unit that we called TAMO, which stood for Telecom, Automotive, and Military Operation. It was kind of a hodgepodge of things. I remember trying to convince Craig to move to Phoenix at the time. As it turned out, he had found a girlfriend in Phoenix and ultimately married her. And so he went from "Hell no, I won't go" to "When can I leave?" And in fact Craig still lives in Phoenix, when he's not in Montana. That was, again, back to these inner relationships between business units and geography and all that sort of thing. I didn't want to make the mistakes that I saw TI making, where they forced people to move. So we convinced people to move to Portland. We moved DRAMs to Portland, we moved all these other businesses to Phoenix, and so forth. And that then became a problem later on, when we had to cut back.

Katz: How so?

Carsten: Well, when we shut down all the memory businesses, a lot of those people had been moved to Oregon. We laid them off, and they couldn't afford to come back. It was not a happy occasion.

Katz: Well, that was one problem. But ultimately wasn't there was some success in the Phoenix and in the Folsom and a few of other remote sites?

Carsten: Yes. And I was in the middle of doing that. The microprocessor thing, it had a lot of good people associated with it. And I give a lot of the credit to Dave House, who was running that operation, as part of my division. It was a pretty successful thing.

The other thing that was controversial, and I was sort of the godfather , was the second sourcing program. At that time, most semiconductors needed to have second sources, or you weren't able to win significant designs. So I set out on a program to second source a lot of our microprocessor peripherals, microcontrollers and other sorts of things. In general, what we did was we licensed a competitor to be able to develop the 8086 microprocessor, which was what they all wanted to do, particularly after the PC was announced.

Katz: I presume the customers were interested in it as well.

Carsten: Yes, but that product had so much momentum. Everybody wanted to build PCs, all over the world. We were able to convince quite a few people to take a license for the 8086 and in return to build peripherals for us, because we needed a plethora of peripherals. We negotiated those agreements with not only AMD, which is the famous one, but also with Hitachi, NEC, Fujitsu, Siemens, SGS. Quite a number of people were licensed to build the [8086] product in return for building peripherals, which then we could build.

Katz: Were those deals successful in that: A, the customers felt comfortable that there would be multiple sources, and B, Intel received good value for their licenses?

Carsten: Well, many of those licensees were also minicomputer and system companies. So in my mind, had we not done that licensing, we would not have won the systems business. Or won nearly as much of it. Places like NEC, Fujitsu, Siemens, Hitachi-- those were primarily systems companies. And they basically refused to use the product unless we allowed their internal operations to build them also. That was sort of their quid pro quo.

Katz: OK, so Intel got good business out of the fact that the licenses were there. Did they also get good return on technology with those peripherals that were due?

Carsten: Not so good. If I remember, we did get a disk controller out of NEC. We got one or two products out of a number of these people. The friction started because the AMD deal was supposed to be one where we would receive a lot of products back, but the contract was very complicated, and it was based on some “complexity units”. AMD was very interested in getting as many complexity unit credits as they could, and so they loaded up their peripherals with a lot of garbage that just made them such power hogs, and expensive, and so forth, that they really weren't very popular. And in the end, we rejected them as being unsatisfactory, and that led to more disputes and problems and finally a big lawsuit.

Katz: About that time, were you still running memories?

Carsten: No. Memories were [then] under Ed Gelbach, and I think, if I remember, Ron Whittier was the GM of the DRAM division. George Schneer was running EPROMs and EEPROM and that sort of thing.

Katz: Were you engaged in Intel's departure from the memory business?

Carsten: Well, in 1983, after some difficulties began to develop in the memory divisions, Dr. Grove asked me to essentially replace Ed Gelbach and give the microprocessor business to Dave House. I took over what was then called the Components Group, although that group also included microcontrollers, all the Phoenix operations and the Folsom operations, and so forth. So I was running all of those businesses, including the factories and the fabs and assembly and so forth.

Katz: Was that assignment to try to rescue the memory business, or to try to kill it?

Carsten: No, to try and rescue it. And so from 1983 to 1985, that's what I did. That was kind of the biggest job I had at Intel. And I think about 75% of the Intel population was working for me then.

It was a big job and a challenging job, and one that in the end was not viewed as a successful enterprise. Although I have a little bit different view of that than Dr. Grove. In his book “Only the Paranoid Survive”, he spent quite a bit of time talking about the agonies that we went through. But stated simply enough, the Japanese were killing us. The reason, among others, was that they approached all the US equipment vendors like Applied Materials, et cetera, and got from them the recipes necessary to build our commodity products. The DRAMs and SRAMs and so forth. They started manufacturing them with almost zero cost of capital in Japan, as the situation is [again] today. And on top of that, the yen was at 240 to the dollar.

Little did we know [in 1985], when the memory businesses were all shut down because of losses and lack of profitability, that within 18 months the yen would be at 130 to the dollar and the economics would be quite different. But we didn't know that at the time, and so the memory businesses struggled.

Katz: My understanding, also, was that the Japanese somehow were better at making cleaner fabs, and even had the economics been equal, they would have had better yields.

Carsten: I don't know if they had better yields or not, but I would say they had a different culture. And it's reflected in the automobile business, in the tire business, and a number of other commodity businesses where their first foot forward is better quality and reliability.

And the history of the DRAM was one of barely being able to build this stuff, and so the concept of producing products where there weren't any bad ones, or that the reliability was 99.999% or something, was sort of alien at Intel and the other US manufacturers. And so I think the Japanese leapt upon this. Hewlett-Packard, for example, gave them terrific publicity in some article where they studied the two [products], and so forth.

But I think all of that really was a clever marketing program. The real issues were more complex and had to do with a lot of the problems that Intel was having in building DRAMs. I was not a big fan of Ron Whittier's strategy, who was running that division, and replaced him with another executive by the name of Dean Toombs. Ron would produce product that was not yielding well, was not meeting all the requirements, and then his solution to the problem was-- well, the 64K is not working so well, but we're going to fix it by building a superior 256K. Oh, well, the 256K isn't working so well, so we're going to fix this by building a better one-meg. Meanwhile, we were losing market share, and the Japanese were really pounding on us.

Some of the other memory divisions were doing well, like the EPROM division, which the Japanese never copied. That technology, with the floating gate, was not well understood at the time. And EEPROM, some other businesses, were fine. But the DRAM business, which was the largest business, was not doing well.

So I think as everyone probably knows already, [anyone] that knows anything about Intel, in 1985 probably the most difficult decision in the company's history was made. And with the leadership of Dr. Grove, the decision was made to shut down the memory businesses. At the time I was running the divisions, and my manufacturing manager, assembly and test manager and so forth, was Craig Barrett. So Craig and I were given the unsavory assignment of laying off 4000 people and closing six factories. The problem was that Intel had a policy of sort of copying exactly, and so we couldn't point to the weakest factories.

Katz: Can you explain the concept of "copy exactly"?

Carsten: The concept was that the specs, the process requirements, the equipment, and the standards which each [manufacturing] facility was held to, were identical. So all the facilities were pretty much performing about the same. This was a terrific idea.

Katz: It sounds like a very obvious thing to do. Why didn't everybody do that?

Carsten: Well, because it's expensive. You have to get the same equipment in, which is an issue, and standardize the processes, which the engineering department doesn't like. It had its issues. But in any event, this "copy exactly" strategy made it extremely difficult to decide which facilities were going to be shut down and which people were going to be laid off.

And in the midst of all of this, as soon as this decision was made, both Andy Grove and Gordon Moore took off on extended overseas vacations. If I remember, Andy went to Israel. Gordon went off on a South

American fishing trip. They were gone during the period that Craig and I were trying to decide which facilities to shut down.

When Grove got back, if I remember, things were really in shambles. This wasn't a decision that was well-supported by the troops or by me. And so it was difficult. I had a strategy for getting Samsung to foundry our DRAMs, and for that matter SRAMs and some other things, and in that way we could continue with the business even though we shut down the factories and eliminated a lot of the costs.

But at the time, and with some justification, Grove did not agree with that. Nor did the board. They didn't trust Samsung. And it was early days. This was before the foundry business really became a big business, and we would have had to transfer all of our DRAM technology to Samsung.

Katz: Wasn't that probably the most advanced technology in the company at the time?

Carsten: Exactly. But we were still shutting it down, so what are you going to do? Anyway, it was a very difficult situation. When Grove got back, he decided to take over the Components Group himself. And that was the end of the Components Group. He asked me to start a custom business in ASICs.-And so that's what I did for the next couple of years.

Katz: Was it that exit from the memory business or some other impetus that caused Intel to finally stop using memories as the technology driver and move it over to the logic products as a technology driver, whose requirements on the technology were different than those of the memory?

Carsten: My recollection is that the primary technology driver was the SRAM. And for some years, even though we were selling very few of them and had basically stopped building DRAMs and ROMs and a bunch of other things, we still used that process. The so-called SRAM process.

Katz: The logic products required SRAM in them.

Carsten: Exactly. And the logic products and the SRAM were still the same [process]. So what I remember is that even though we discontinued many products and backed out of a lot of businesses, we still used that process as sort of the engine to drive everything and get the yields up, and shrink and so forth.

Katz: Let's come back into the last part of your time at Intel, where you were running the ASIC business, the custom business. How'd that go?

Carsten: Well, it was a tough assignment because the [industry] leaders at the time were LSI Logic and VLSI Technology, my old buddy Al Stein. They had developed a lot of custom CAD tools and software in order to do custom chip design.

Intel purchased [design] tools from the major vendors like Cadence and Synopsys, but those tools were not the sort of thing that ASIC designers needed. So leaning on my IBM experience, I went to IBM and was able to negotiate a licensing deal with them where they supplied us with their custom CAD and design tools, and allowed us to resell them and license to our customers.

Katz: Was there a quid pro quo on that as well? Did they get anything out of that deal?

Carsten: Well, they got the continuing second sourcing rights to the microprocessors. And in addition we agreed to supply them several hundred million dollars' worth of their own custom porcupine chips that they needed for various applications within IBM. I think at the time, since IBM owned 20% of Intel, there was also a desire to have us be a vendor.

Katz: OK, you got the IBM ASIC development tools.-- I recall it was a pretty big development tool. It was bigger than Intel had ever had before.

Carsten: Right. We had quite a project to customize it and make it applicable to the industry-used products. I can remember talking to a number of the workstation manufacturers in order to port this stuff over to them and get all this to work. Because at IBM all the tools were run on mainframes, but that wasn't, generally speaking, the way our customers did it.

So there was a lot of work to be done there, as well as the development of a family of ASIC logic that could compete with people like LSI Logic and VLSI. We had some macros that were important, like the 8051 and a number of things that were unique to us. But that was quite a project.

And it was successful. In two years I think we got it up to about $200 million of revenue, and it was going pretty well. But then something happened that killed the business.

Dr. Grove and Dave House decided that it was hurting Intel to continue the policy of second sourcing the microprocessors, which I had been kind of a champion of. And so they proceeded to cancel most of the licenses that were outstanding, or at least not extend them to the new 386, which was a real blockbuster product. That caused the big lawsuit with AMD. And in the case of IBM, IBM had rights to build Intel microprocessors for their own use only, and to supply up to 50% of their requirements as well as customizing them and so forth.

That license technically didn't extend to the 386, but everyone expected that we would extend it. But instead, the decision was made to cancel that license. That just infuriated IBM like nothing I've ever seen. Because among other things, at the time, they owned 20% of Intel.

And so in retaliation, they canceled the CAD licensing contract that I was using to run the ASIC business. They canceled all the [orders for the] custom chips that I was selling them. And they sold their 20% interest in Intel.

That caused Intel stock to crash. It went to-- I think in 1987 it went to like $15 a share. And it just killed my business.

Katz: Did the perpetrators acknowledge the mistake?

Carsten: Well, they didn't think it was a mistake. Grove wrote another book. He thinks it's the greatest decision he ever made. And so does Dave House. I read his oral history, and he still thinks it's a great decision.

I have to confess, it probably was a great decision. But at the time, that wasn't my point of view, particularly. Because I was the victim. I had a lot of venture offers. I had been the fourth-highest-paid Intel exec for some years. And so that was when I decided to leave. The period from '85 to '87 was not a great time for Intel. It was a time the business was not growing. We reported substantial losses in '85, and revenue actually went down from I think $1.6 billion to $1.3 billion. Something like that. So there were a lot of questions at the time about whether Intel was going to succeed. It looks, in retrospect, kind of minor. But if you were living it, it was not.

Katz: Before we leave Intel, let's recap a little bit. You've listed a number of problems you encountered and how you dealt with them, and you've listed a number of accomplishments. Of the accomplishments, which are you most satisfied with and happy that you got the chance to do them?

Carsten: Well, the period of time when Intel grew from about $300 million to I think $1.5 billion or so-- that was just really an exciting time. We had a group of outstanding executives, and we were building a brand

new business of complex logic and microprocessors. The period from probably 1976 to 1983 or so is certainly the period of time that I enjoyed the most. Even running the memory businesses was interesting, and trying to do a turnaround there was interesting. But thereafter things really became tough, and I would never want to be involved in anything like the layoff there [which] I had to do.

Katz: Indeed. Did you have any particular mentors at Intel who influenced you well into your later career or during your time at Intel?

Carsten: Well, all the top people at Intel, I think, were outstanding executives. I was particularly impressed with Bob Noyce, who was both a scientist and a gentleman, a superb marketeer, and really had, I think, tremendous business insight.

Gordon Moore was more of the Mr. Inside, and more concerned about everything from the learning curve and Moore's law and what it took to do all that stuff, which is actually pretty significant and difficult, and not an area that I was particularly proficient in. I wasn't part of the technology development part of Intel.

Andy Grove was a dynamo, a tyrant, and a terrific teacher. I think that Andy's skills in taking young execs-- not just myself, but a lot of others-- and turning them into fine general managers was outstanding. I think the weakness that Andy had, though, was that he never recognized the significance of sales and marketing. Marketing strategies, some of the things we talked about earlier. Distributor strategy, pricing strategy, schmoozing. All those things were just totally alien to Andy.

And unfortunately, in my view, he drove off his best business managers. Not just myself, but Bill Davidow, Dave House, Bill Lattin. The list goes on and on. And at one point Dr. Grove announced, and even announced publicly, that he was going to retire-- if I recall, at age 55. And he brought in three key executives-- I was one of them-- and said, we haven't decided yet, but one of you is going to be the next president of Intel.

As it turned out, he then reneged on his retirement. None of us became the next president, and we all left. So that's kind of a lowlight in the history of Intel, because as fine an executive as Craig Barrett was, he was a manufacturing guy, and Intel didn't need a manufacturing guy at that point in their history.

They spent $10 billion trying to get into the mobile business, and that was a complete failure. Well, part of the reason was that most of the really key business executives in the company had left. And I think this was a characteristic of Andy's, that he was a great teacher and liked to take young executives and teach them how to run the business. And in so doing, he had to push aside the more senior executives and put them in the staff roles and other places where they were uncomfortable. And so they left.

So Andy was both my greatest mentor but also, I would say, a frustrating guy to work for, because he really focused on manufacturing, on results, on profits, and that sort of thing. The finer aspects of marketing strategy were not his forte.

Katz: You've had a pretty productive career with the big companies, and ultimately decided to leave Intel. And you've described pretty much why that may have been the appropriate time to leave Intel. Let's hear about where you went to from Intel, and why you chose that direction.

Carsten: Well, I often say I either left Intel too early or too late. Too late in the sense that some of my friends like Bill Davidow, John Doerr, a number of people who left Intel in the early '80s, got into the venture business at a very timely period and did quite well. Obviously had a lot of talent there.

And then on the other side of the equation, you've got people like Dave House, Les Vadasz, Jerry Parker and so forth, that sort of rode out the course. And in many cases-- Dave is a good example-- they were

actually in staff positions and didn't really have that much to do because Grove had moved them out of their line positions in his interest to bring in the young, fresh, and new.

So I left in 1987 and went to US Venture Partners, which was quite a successful firm at the time. However, this reminds me of when I left and went to Intel. Just about the time I left, after I turned in my resignation, there was a stock market crash in 1987. And I literally was asking people whether I should be leaving and going into the venture business.

As it turned out, while US Venture Partners (at the time), I think, was a fine firm, it was quite a transition for me. And being in a big venture partnership, it's almost like being in a law firm. Everybody keeps their own book, works their own deals, and other than getting together and deciding what new deals you're going to do, there isn't the same sort of corporate structure in place that you have in a large company.

Katz: Well, throughout your career weren't you always taking on new responsibilities for which you had little or no previous experience?

Carsten: Yeah, well. I certainly enjoyed building companies and teaching young execs how to prosper. So I felt I would be good at that,.And as it turned out, I think I was. But it was quite a transition.

And then the other problem with US Venture Partners was that there were four senior partners and I think six or seven junior partners. And the four senior partners who had raised [all] three funds suddenly all came down with a variety of life-threatening illnesses and various problems. If I recall, one had three angioplasties in nine months' time and was told he couldn't work.

Another one came off of a triple bypass and was diagnosed with lymphoma, and a third suffered a breakdown and went back to the UK. The fourth founder was convicted of income tax evasion.

Katz: Whoa. That's just like what happened when you had to move to Houston, right? The big guys are gone, and you get a chance.

Carsten: The difficulty was I'd only been there a couple of years, had no track record, and the fund was desperately trying to raise a follow-on fund. It ended up taking them eight years to raise a follow-on fund from the '86 fund that I joined and was a GP.

And in so doing, and I ended up having to recruit somebody to run the [USVP] technology group to replace this fellow who ultimately did die. I recruited Irwin Federman, whom I knew. The former CEO of Monolithic Memories. He had gone to a fund called Concord in New York City and actually had a substantial successful venture track record, which I didn't have [in 1990]. The difficulty was that there wasn't enough money in the fund to support both of us, so I ended up stepping aside and starting a small seed fund called Technology Investments.

Fast forward about five years, and by this time then I had had seven IPOs and three successful buyouts, and my IRR was in the sky. And at that point in time I was being deluged with requests to start my own fund, and so in 1998 and '99, we started Horizon Ventures, backed largely by the Itochu Group in Japan.

Katz: Before we get on to Horizon, let's back up a second. You just mentioned you had seven successful IPOs over several years. How did you bootstrap yourself from not being able to raise a fund to getting your companies to the point where they could have a successful IPO?

Carsten: Well, even though I needed to step down as a GP at USVP and basically give up my fee income, which was substantial, to Irwin-- and I agreed to do that-- I stayed on the boards of the companies that I had been involved with and helped them to be successful. The difficulty was that the first

IPO took six years, and the last one before I formed Horizon-- I think took 10 years. And so there was this long period of time when there wasn't--

Katz: There's a good time for IPOs, and a not-so-good time.

Carsten: That's right. And the late '90s was obviously a terrific time. Everybody was making a lot of money. I made more money from the second fund that USVP [started in 1994] than I did from the one I joined to be a GP, by investing in that fund. And that was successful.

But anyway, so then I started Horizon, along with another ex-Intel fellow by the name of John Hall, in 1999. The difficulty was that the timing was poor. We made our first investment in March of 2000, as we were watching the stock market go straight down. We struggled with those issues, and we ended up raising a second fund backed by the SBA in, I think, 2004. Today we still have those companies. And some of the companies, you know, I've been on the board for 10 or 12 years. We're slowly exiting.

Katz: On how many boards do you sit nowadays?

Carsten: I think I'm still on four boards, but over the course of my career I think I've been on between 30 and 40 boards. Some of that was done when I was doing angel investing with the Band of Angels.

Katz: Can you elaborate a little bit more about your engagement with the Band of Angels?

Carsten: Well, when I was running Technology Investments, I ran into a fellow by the name of Hans Severiens, who was running a Dutch fund. We were both doing seed investments and making investments of maybe a quarter million dollars or something like that. And it was really difficult to get syndicates together, to get other angels interested in investing. He had the idea of starting a dinner club, where we could give a bunch of wealthy individuals a free dinner and then parade a few companies in front of them. And in that way it would be a lot more efficient than what we were doing now, which was basically setting up individual appointments and going off with our entrepreneurs and trying to pitch these things.

Katz: Interesting concept. Did it work?

Carsten: Well, when he approached me about it I said," Look, Hans, you're welcome to my Rolodex, I'll be glad to help you, but I want to have nothing to do with the administration and overhead associated with this." And he said yep, fine, he would do that.

We brought in another fellow by the name of Fred Hoar, who at the time was the head of Marcom at Apple. Fred was a big draw to the Band of Angels, because he would come, every meeting, and give the State of the Union of Silicon Valley. And he was a fantastic speaker.

But unfortunately both Fred and Hans died about five or six years ago. The Band of Angels is now run by a fellow by the name of Ian Sobieski, who has really gotten it very well organized, with the various SIGs and subgroups and recruiting efforts, and different kinds of social activities and so forth. I think he's really done a better job than Hans did back in the early days. And as a result, it is a very successful angel group here in Silicon Valley. I think they have about 150 members, and we meet every month.

Katz: You're still engaged with it?

Carsten: I'm still involved in it, yes. In fact, I was in a meeting yesterday.

Katz: Do you happen to find investments, or you just like the networking?

Carsten: Oh, no. Since I'm no longer making new investments at Horizon, I do make investments through the Band.

Katz: Before we leave Horizon, are there major successes there that you'd like to share, or maybe major frustrations?

Carsten: Well, Horizon hasn't had any IPOs. We've had a fair number of successful buyouts. One, we sold a semiconductor company about a year ago called iWatt for $350 million or so. And that was an example-- I think I was on that board for 12 years. They were a manufacturer of the chips that are used in the i Phone chargers. That was their primary business.

But yes, we've had highlights and lowlights. I would say the biggest frustration that we have had as a venture firm has been what I would call “syndicate failure”. As interest in semiconductors, networking, and to a certain extent things like CAD software and other areas that we invested in-- as those did not become as exciting as internet investments and security and some other areas, why, we had difficulty raising the follow-on rounds. And usually that was because the larger firms that we were invested with would have a big jump-shift into new areas, and they wouldn't want to do the follow-on investing [rounds]. I had a couple of semiconductor deals that we co-invested with Sequoia, for example, and Sequoia doesn't do semiconductors anymore. The partners that were doing that all left, and so the deals we had with them, they pulled out. And it cost us some considerable angst. It's a particular issue for smaller funds, because we're not big enough to just pick up the ball and carry the whole load. And particularly in a networking or semiconductor company that might need, I don't know, $25 million, we're a $150 million fund. So we're not the size to do that [alone].

Katz: We're getting close to the end here. Let's just do a little bit of recap first from the past, and then we'll look to the future. Of all the things we discussed today, and all throughout your career, what do you rate as the most exciting and rewarding part, or satisfying part of your career?

Carsten: Well, the period that sort of started with my Houston experience at TI through the logic businesses at Intel I think are the areas that were the most satisfying, that grew a number of businesses. I still have a lot of friends and a lot of exciting memories of those periods.

Katz: Of which accomplishment are you most proud? When you're going to talk to your mom and say what you did for your life, what do you tell her?

Carsten: Oh, I don't know that there's one thing that stands out. I would say probably the most difficult assignment that turned out very well for me and kind of kicked off my career was running the TTL business [at TI]. To go from a young marketing engineer to running TI's fastest-growing business.

Katz: Is there any one event or activity that you regret in that long chain of events?

Carsten: It wasn't anything that I could've foreseen, but I kind of regret the decision to join US Venture Partners [in 1987] instead of some other firm.

Katz: Yeah, where the whole senior team disappears on you.

Carsten: As I mentioned to you, I had no more than got there than the stock market crashed and the team collapsed. And I just didn't have a skill bank to do anything about that. As I said, I left Intel either too early or too late.

Katz: Let's now start looking toward the future here. Are you going to continue being an investor, either an angel investor or any other kind of stuff?

Carsten: I don't intend to stop investing, and I can assure you I'm not short of opportunities that come my way. You know, 50 emails a week of various kinds of opportunities.

Katz: Are you looking at any particular aspects of technology that you think are the big thing in the future?

Carsten: I think there's going to be many big things, but most of them are going to be driven by mobile devices. I think the proliferation of powerful mobile devices around the world-- and I'm thinking of the second and third-world countries more than the US-- is going to cause a revolution in society. And exactly what has to be done there is still evolving.

Katz: Is that the biggest challenge you see coming ahead? What to do with all the mobile capability?

Carsten: I think the biggest challenge is actually Internet security. My view is that Internet security is sort of-- the suicide bomber of the internet. The kinds of things that have happened so far in that area, in my mind, are just a small microcosm of what's going to happen. And I don't think the governments of the world, or even the industry, really understand what to do about that.

Katz: You and I grew up in the era of a technology being a hardware manufacturing industry. We had to learn engineering in the sense of milliamps and nanoseconds, and we had to learn some about economics. What do you think the job challenges are going to be in the future for young people who want to continue in technology? Will they have to have the same skills we did, or other ones?

Carsten: Well, my advice to people that ask me where should they go, I tell them go where the growth is. Right now those growth areas, in my mind, are things like biotech. Software is a huge business right now, and I think hardware, certainly semiconductors and a lot of computer hardware things, have become commodity, And so you need to go where the growth is. Otherwise the opportunities are not going to exist.

For example, I was in semiconductors for almost 50 years in one way or another, part of it as an investor. And the business grew for the first 40 years at a rate of 15% to 20% a year. Almost everybody I knew from my days back at TI, they're all millionaires. And the reason is that the rate of growth of the business just sucked up every resource that could be found to fill the obvious growth opportunities. Right now, I think you have to decide where that is [going to be].

Katz: Probably not chip manufacturing anymore.

Carsten: It's certainly not chip manufacturing.

Katz: Yeah, I would agree with you that software seems to be the place where all the resources are going to get sucked up for the next foreseeable future.

So you have advice for young persons trying to get into technology: Go where the growth is. Anything else you want to say to your grandchildren?

Carsten: Well, I think the results of the development of the semiconductor business and its effect on society is just, to me, astounding. I agreed with some comments that Gordon Moore made probably 20, 25 years ago. "Who's going to use all these functions? If we build all these chips, what in the world is ever going to happen to them?" With the strengths of software development, that doesn't seem to be a problem. I continue to be astounded at what's happened in technology as a result of the silicon chip. Yet the chip itself has become commoditized now. And so what does that mean? Does it mean that the technology could step back, or we could lose the recipes? I don't know. I don't think so.

Katz: Well, if all the good people go into some other higher-growth area, we could have some kind of backlash.

Carsten: Yeah, but now that an awful lot of the manufacturing is done in places like China and Israel and Eastern Europe and so forth. If the US [companies] could not buy chips from other countries or from a group of other countries, they certainly can't manufacture them anymore. Other than a few Intel factories and a couple of IBM factories, I don't think there's much left in the way of cutting-edge [semiconductor] technology here in the US.

Katz: Well, so far the world's been able to deal with a number of industries that do exactly that. I mean, you don't buy tires from Akron anymore.

Carsten: Exactly. Or build cars, or a lot of other things.

Katz: Well, I think our time is up here. For the few hours we've spent together, I want to thank you. The Computer History Museum thanks you, and our ultimate viewers will thank you.

END OF INTERVIEW

